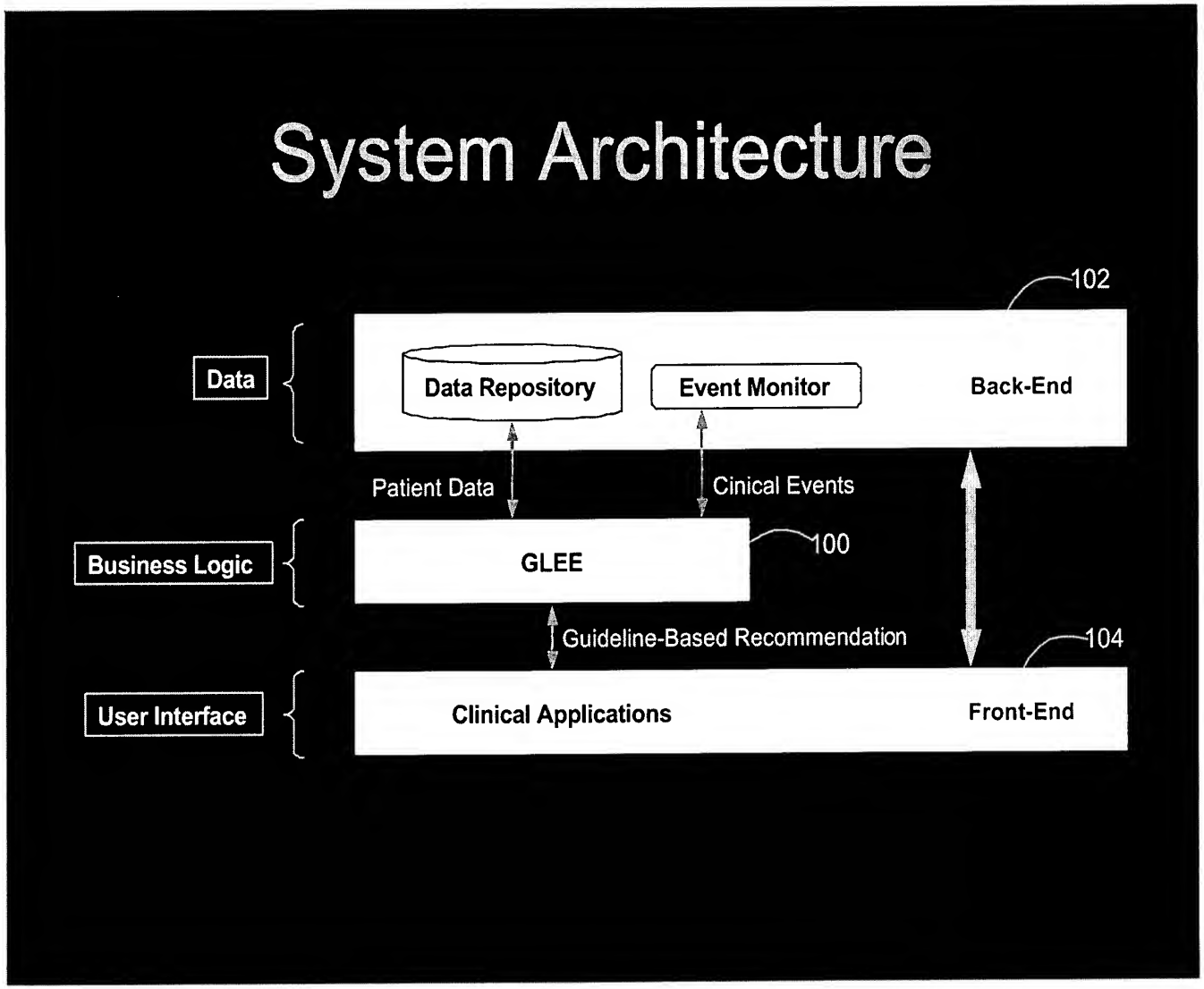
System Architecture
102
Data
Data Repository
Event Monitor
Back-End
Patient Data
Cinical Events
Business Logic
GLEE
100
Guideline-Based Recommendation
104
User Interface
Clinical Applications
Front-End

Fig. 1

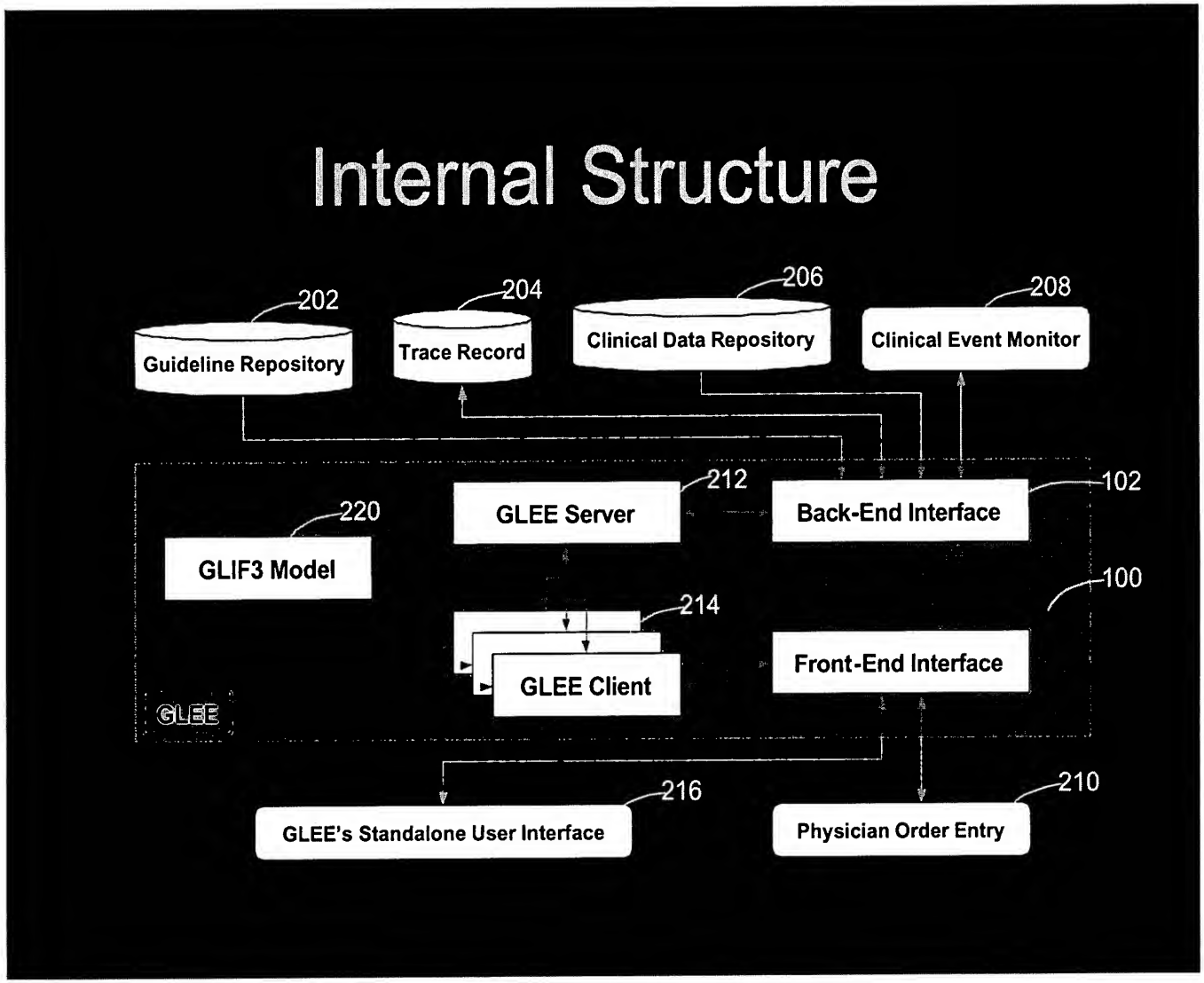
Internal Structure
202
Guideline Repository
204
Trace Record
206
Clinical Data Repository
208
Clinical Event Monitor
212
GLEE Server
102
Back-End Interface
220
GLIF3 Model
100
214
GLEE Client
Front-End Interface
GLEE
216
GLEE's Standalone User Interface
210
Physician Order Entry

Fig. 2

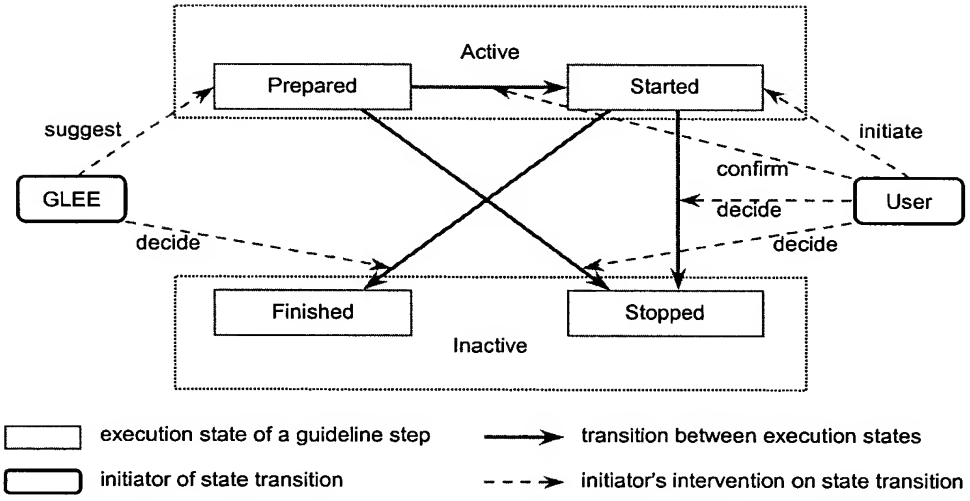
Active
Prepared
Started
suggest
initiate
confirm
GLEE
User
decide
decide
decide
Finished
Stopped
Inactive
execution state of a guideline step
transition between execution states
initiator of state transition
initiator's intervention on state transition

Fig. 3

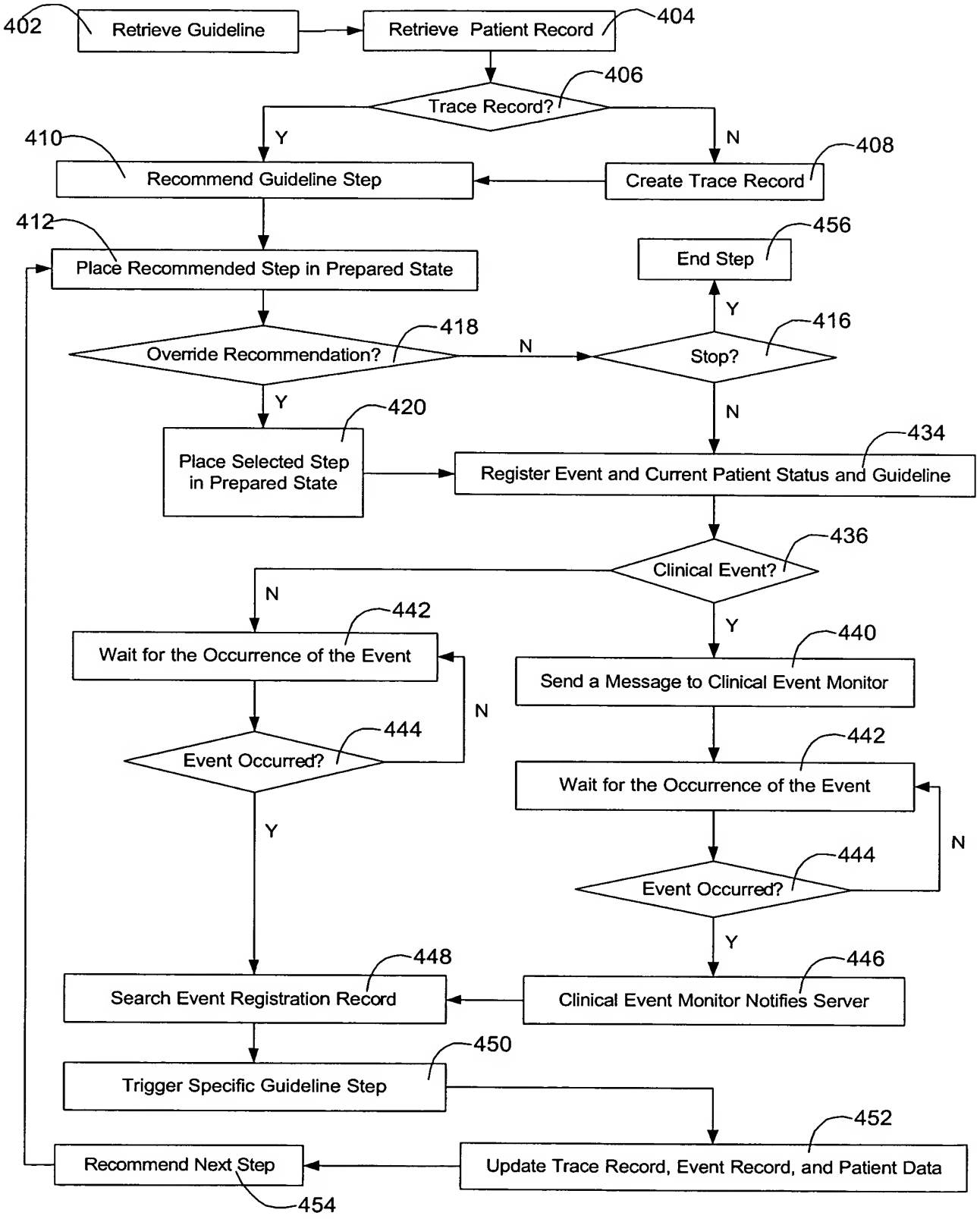
402
Retrieve Guideline
Retrieve Patient Record
404
406
Trace Record?
Y
N
410
Recommend Guideline Step
Create Trace Record
408
412
Place Recommended Step in Prepared State
456
End Step
Y
418
Override Recommendation?
N
Stop?
416
Y
N
420
Place Selected Step in Prepared State
434
Register Event and Current Patient Status and Guideline
436
Clinical Event?
N
Y
442
Wait for the Occurrence of the Event
440
Send a Message to Clinical Event Monitor
N
444
Event Occurred?
442
Wait for the Occurrence of the Event
Y
N
444
Event Occurred?
Y
448
Search Event Registration Record
446
Clinical Event Monitor Notifies Server
450
Trigger Specific Guideline Step
452
Recommend Next Step
Update Trace Record, Event Record, and Patient Data
454

Fig. 4

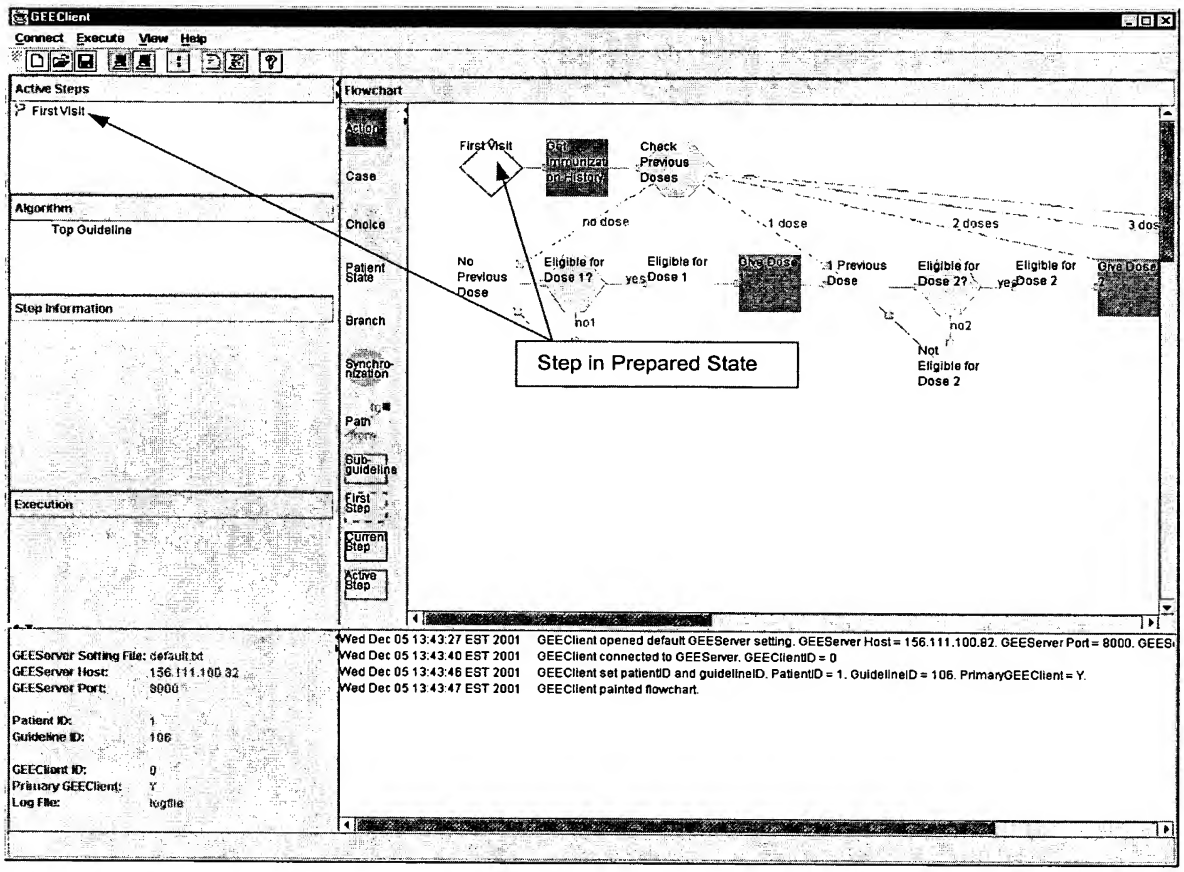
GEEClient
Connect Execute View Help
Active Steps
First Visit
Algorithm
Top Guideline
Step Information
Execution
Flowchart
Action
Case
Choice
Patient State
Branch
Synchro-nization
Path
Sub-guideline
First Step
Current Step
Active Step
First Visit
Get Immunization History
Check Previous Doses
no dose
1 dose
2 doses
No Previous Dose
Eligible for Dose 1?
yes
Eligible for Dose 1
Give Dose 1
1 Previous Dose
Eligible for Dose 2?
yes
Eligible for Dose 2
Give Dose 2
no1
no2
Not Eligible for Dose 2
Step in Prepared State
GEEServer Setting File: default.txt
GEEServer Host: 156.111.100.82
GEEServer Port: 8000
Patient ID: 1
Guideline ID: 106
GEEClient ID: 0
Primary GEEClient: Y
Log File: logfile
Wed Dec 05 13:43:27 EST 2001 GEEClient opened default GEEServer setting. GEEServer Host = 156.111.100.82. GEEServer Port = 8000.
Wed Dec 05 13:43:40 EST 2001 GEEClient connected to GEEServer. GEEClientID = 0
Wed Dec 05 13:43:46 EST 2001 GEEClient set patientID and guidelineID. PatientID = 1. GuidelineID = 106. PrimaryGEEClient = Y.
Wed Dec 05 13:43:47 EST 2001 GEEClient painted flowchart.

Fig. 5

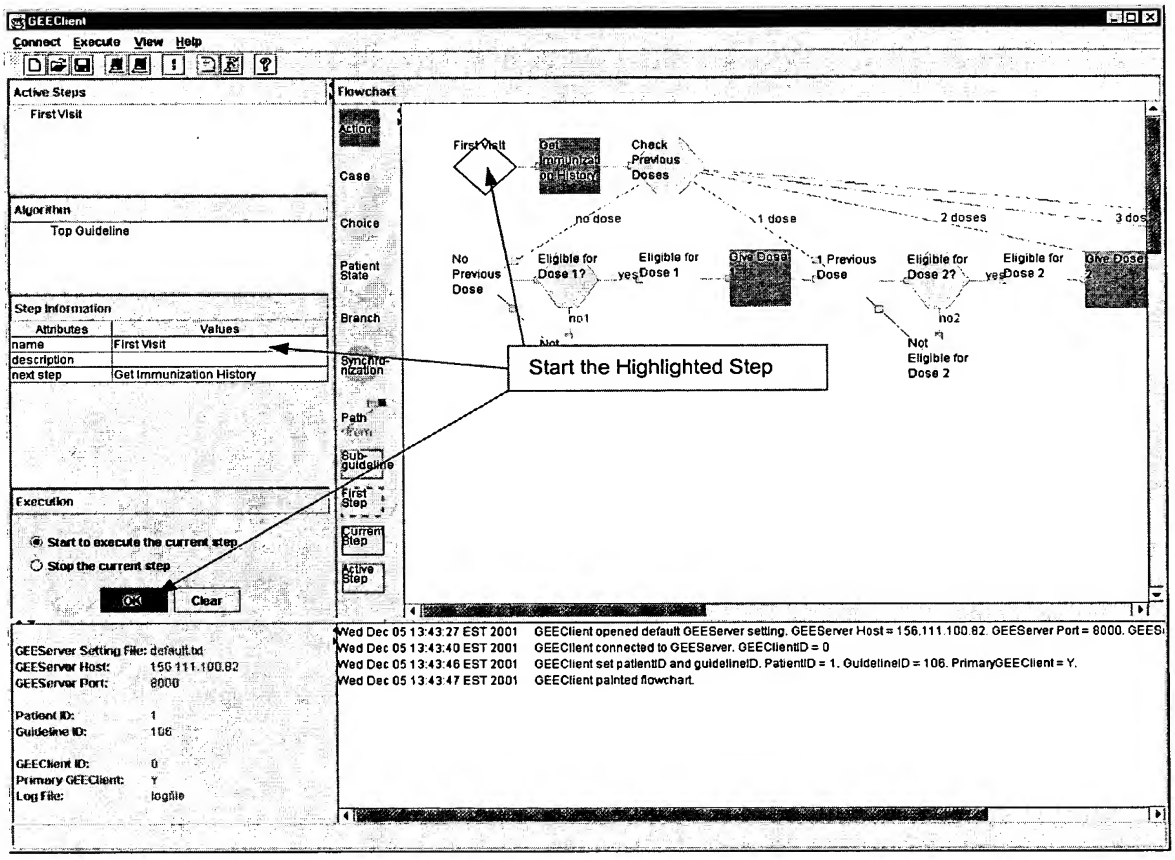
GEEClient
Connect Execute View Help
Active Steps
First Visit
Algorithm
Top Guideline
Step Information
Attributes
Values
name
First Visit
description
next step
Get Immunization History
Execution
Start to execute the current step
Stop the current step
OK
Clear
Flowchart
Action
Case
Choice
Patient State
Branch
Synchronization
Path
Sub guideline
First Step
Current Step
Active Step
First Visit
Get Immunization History
Check Previous Doses
no dose
1 dose
2 doses
3 dos
No Previous Dose
Eligible for Dose 1?
yes
Eligible for Dose 1
Give Dose
1 Previous Dose
Eligible for Dose 2?
yes
Eligible for Dose 2
Give Dose
no1
no2
Not Eligible for Dose 2
Start the Highlighted Step
GEEServer Setting File: default.txt
GEEServer Host: 156.111.100.82
GEEServer Port: 8000
Patient ID: 1
Guideline ID: 106
GEEClient ID: 0
Primary GEEClient: Y
Log File: logfile
Wed Dec 05 13:43:27 EST 2001 GEEClient opened default GEEServer setting. GEEServer Host = 156.111.100.82. GEEServer Port = 8000. GEES
Wed Dec 05 13:43:40 EST 2001 GEEClient connected to GEEServer. GEEClientID = 0
Wed Dec 05 13:43:46 EST 2001 GEEClient set patientID and guidelineID. PatientID = 1. GuidelineID = 106. PrimaryGEEClient = Y.
Wed Dec 05 13:43:47 EST 2001 GEEClient painted flowchart.

Fig. 6

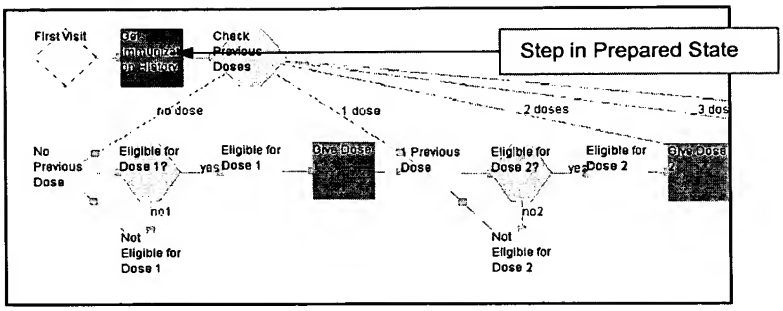

Fig. 7

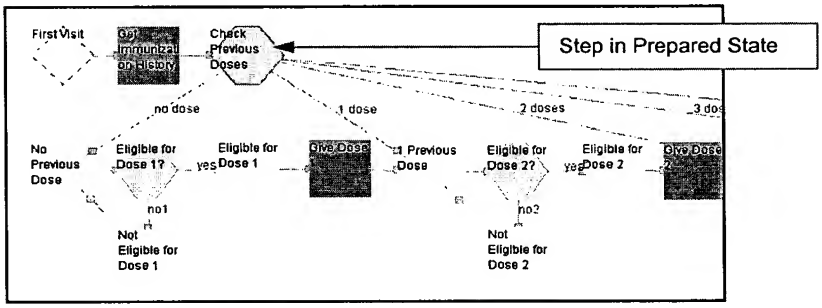

Fig. 8

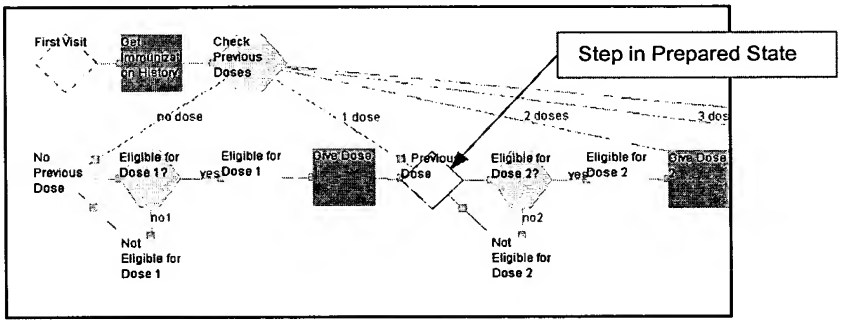

Fig. 9

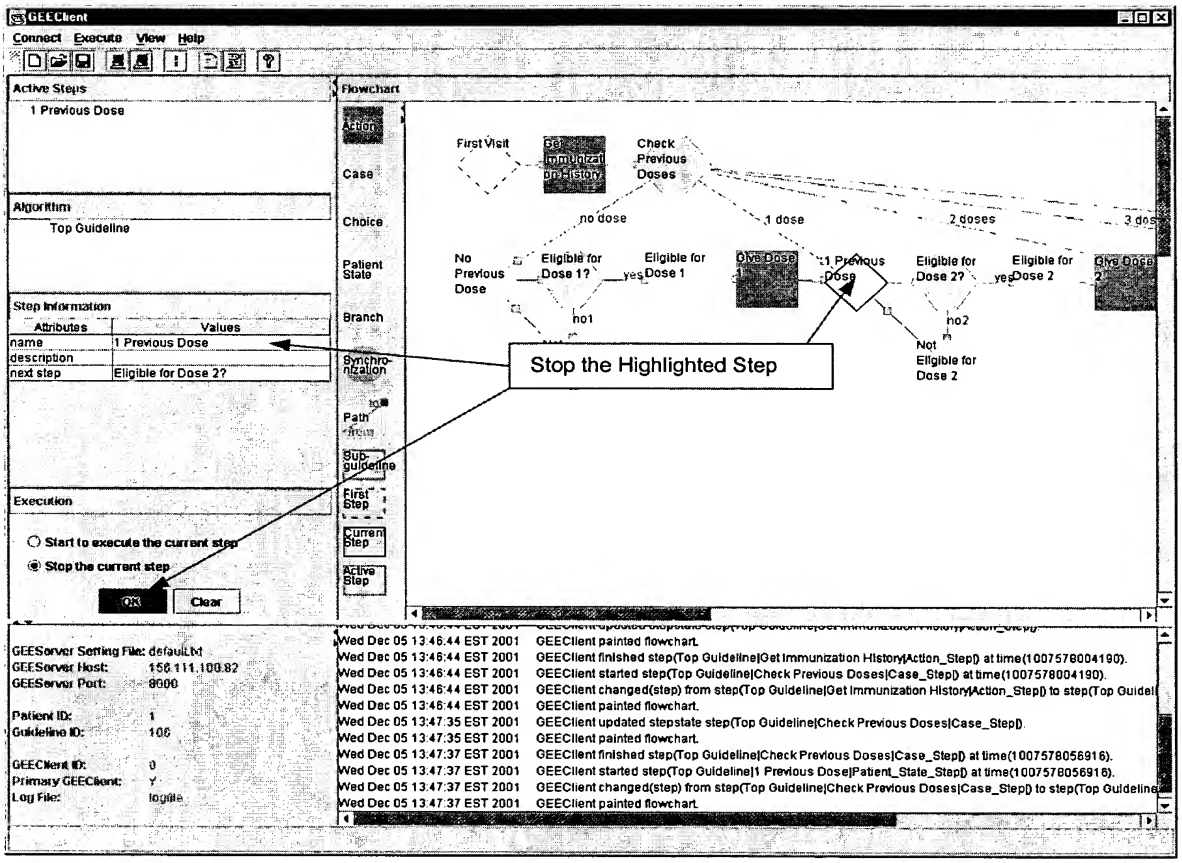
GEEClient
Connect Execute View Help
Active Steps
1 Previous Dose
Algorithm
Top Guideline
Step Information
Attributes
Values
name
1 Previous Dose
description
next step
Eligible for Dose 2?
Execution
Start to execute the current step
Stop the current step
OK
Clear
Flowchart
Action
Case
Choice
Patient State
Branch
Synchro-nization
Path
Sub-guideline
First Step
Curren Step
Active Step
First Visit
Check Previous Doses
no dose
1 dose
2 doses
3 dos
No Previous Dose
Eligible for Dose 1?
Eligible for Dose 1
Give Dose
1 Previous Dose
Eligible for Dose 2?
Eligible for Dose 2
Give Dose 2
yes
no1
no2
Not Eligible for Dose 2
Stop the Highlighted Step
GEEServer Setting File: default.txt
GEEServer Host: 156.111.100.82
GEEServer Port: 8000
Patient ID: 1
Guideline ID: 106
GEEClient ID: 0
Primary GEEClient: Y
Log File: logfile
Wed Dec 05 13:46:44 EST 2001 GEEClient painted flowchart.
Wed Dec 05 13:46:44 EST 2001 GEEClient finished step(Top Guideline|Get Immunization History|Action_Step|) at time(1007578004190).
Wed Dec 05 13:46:44 EST 2001 GEEClient started step(Top Guideline|Check Previous Doses|Case_Step|) at time(1007578004190).
Wed Dec 05 13:46:44 EST 2001 GEEClient changed(step) from step(Top Guideline|Get Immunization History|Action_Step|) to step(Top Guideli
Wed Dec 05 13:46:44 EST 2001 GEEClient painted flowchart.
Wed Dec 05 13:47:35 EST 2001 GEEClient updated stepstate step(Top Guideline|Check Previous Doses|Case_Step|).
Wed Dec 05 13:47:35 EST 2001 GEEClient painted flowchart.
Wed Dec 05 13:47:37 EST 2001 GEEClient finished step(Top Guideline|Check Previous Doses|Case_Step|) at time(1007578056916).
Wed Dec 05 13:47:37 EST 2001 GEEClient started step(Top Guideline|1 Previous Dose|Patient_State_Step|) at time(1007578056916).
Wed Dec 05 13:47:37 EST 2001 GEEClient changed(step) from step(Top Guideline|Check Previous Doses|Case_Step|) to step(Top Guideline
Wed Dec 05 13:47:37 EST 2001 GEEClient painted flowchart.

Fig. 10

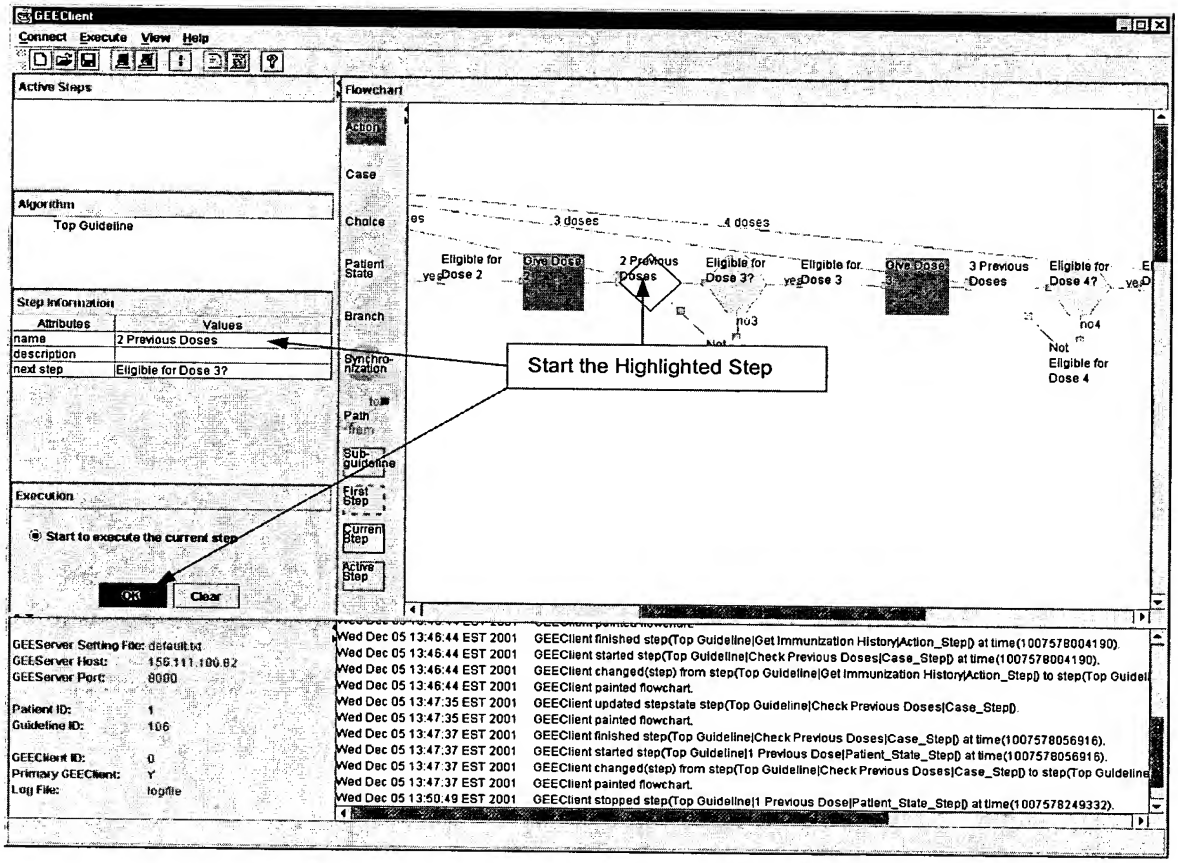
GEEClient
Connect Execute View Help
Active Steps
Flowchart
Algorithm
Top Guideline
Step Information
Attributes
Values
name
2 Previous Doses
description
next step
Eligible for Dose 3?
Execution
Start to execute the current step
OK
Clear
Action
Case
Choice
Patient State
Branch
Synchro-nization
Path
Sub-guideline
First Step
Current Step
Active Step
3 doses
4 doses
Eligible for Dose 2
2 Previous Doses
Eligible for Dose 3?
Eligible for Dose 3
3 Previous Doses
Eligible for Dose 4?
Start the Highlighted Step
Not Eligible for Dose 4
GEEServer Setting File: default.txt
GEEServer Host: 156.111.100.82
GEEServer Port: 8000
Patient ID: 1
Guideline ID: 106
GEEClient ID: 0
Primary GEEClient: Y
Log File: logfile
Wed Dec 05 13:46:44 EST 2001 GEEClient finished step(Top Guideline|Get Immunization History|Action_Step|) at time(1007578004190).
Wed Dec 05 13:46:44 EST 2001 GEEClient started step(Top Guideline|Check Previous Doses|Case_Step|) at time(1007578004190).
Wed Dec 05 13:46:44 EST 2001 GEEClient changed(step) from step(Top Guideline|Get Immunization History|Action_Step|) to step(Top Guideli
Wed Dec 05 13:46:44 EST 2001 GEEClient painted flowchart.
Wed Dec 05 13:47:35 EST 2001 GEEClient updated stepstate step(Top Guideline|Check Previous Doses|Case_Step|).
Wed Dec 05 13:47:35 EST 2001 GEEClient painted flowchart.
Wed Dec 05 13:47:37 EST 2001 GEEClient finished step(Top Guideline|Check Previous Doses|Case_Step|) at time(1007578056916).
Wed Dec 05 13:47:37 EST 2001 GEEClient started step(Top Guideline|1 Previous Dose|Patient_State_Step|) at time(1007578056915).
Wed Dec 05 13:47:37 EST 2001 GEEClient changed(step) from step(Top Guideline|Check Previous Doses|Case_Step|) to step(Top Guideline
Wed Dec 05 13:47:37 EST 2001 GEEClient painted flowchart.
Wed Dec 05 13:50:49 EST 2001 GEEClient stopped step(Top Guideline|1 Previous Dose|Patient_State_Step|) at time(1007578249332).

Fig. 11

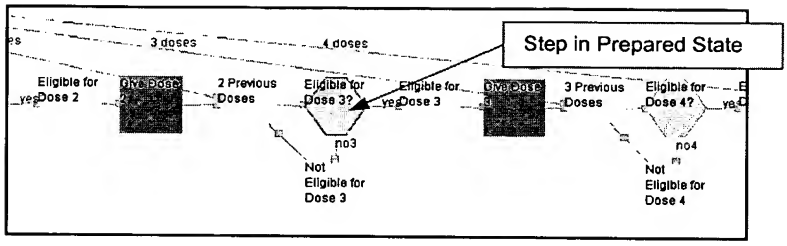
Step in Prepared State
3 doses
4 doses
Eligible for Dose 2
2 Previous Doses
Eligible for Dose 3?
Eligible for Dose 3
3 Previous Doses
Eligible for Dose 4?
no3
Not Eligible for Dose 3
no4
Not Eligible for Dose 4

Fig. 12

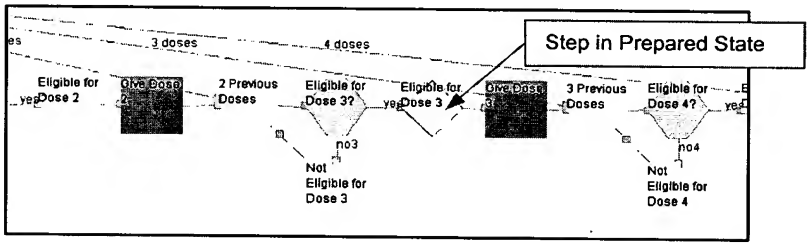
Step in Prepared State
3 doses
4 doses
Eligible for Dose 2
2 Previous Doses
Eligible for Dose 3?
Eligible for Dose 3
3 Previous Doses
Eligible for Dose 4?
no3
Not Eligible for Dose 3
no4
Not Eligible for Dose 4

Fig. 13

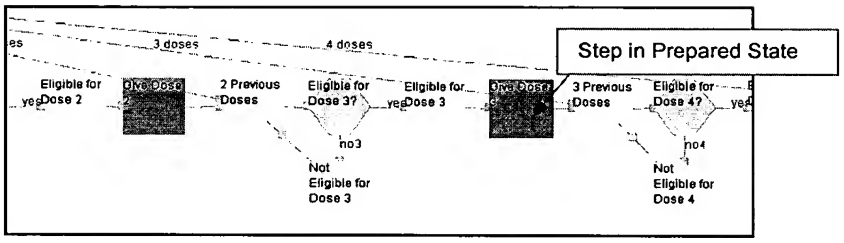
Step in Prepared State
3 doses
4 doses
Eligible for Dose 2
Give Dose
2 Previous Doses
Eligible for Dose 3?
Eligible for Dose 3
Give Dose
3 Previous Doses
Eligible for Dose 4?
no3
Not Eligible for Dose 3
no4
Not Eligible for Dose 4

Fig. 14

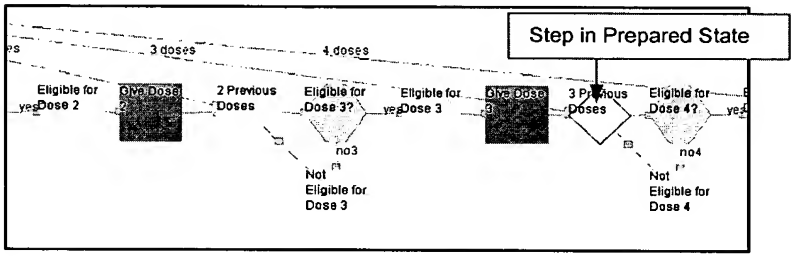
Step in Prepared State
3 doses
4 doses
Eligible for Dose 2
Give Dose
2 Previous Doses
Eligible for Dose 3?
Eligible for Dose 3
Give Dose
3 Previous Doses
Eligible for Dose 4?
no3
Not Eligible for Dose 3
no4
Not Eligible for Dose 4

Fig. 15

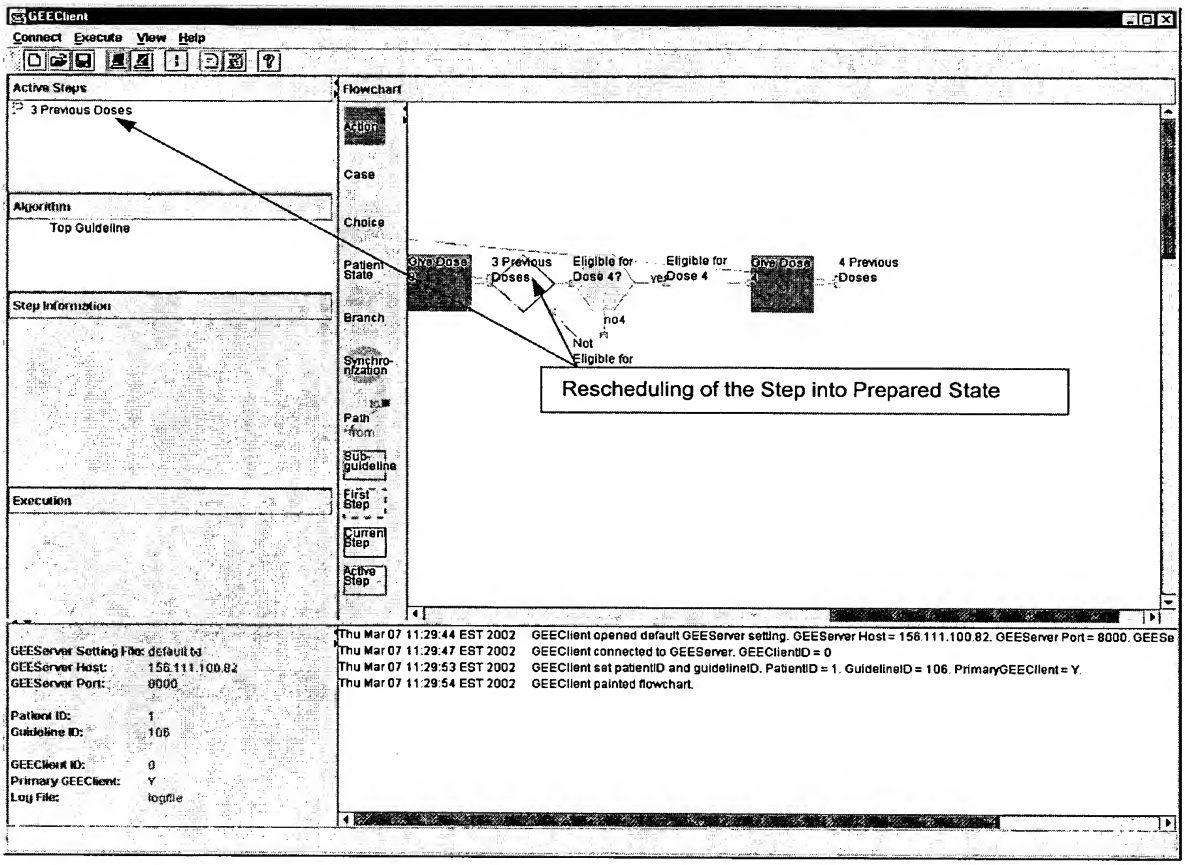
GEEClient
Connect Execute View Help
Active Steps
3 Previous Doses
Algorithm
Top Guideline
Step Information
Execution
Flowchart
Action
Case
Choice
Patient State
Branch
Synchro-nization
Path from
Sub-guideline
First Step
Current Step
Active Step
Give Dose
3 Previous Doses
Eligible for Dose 4?
Eligible for Dose 4
Give Dose
4 Previous Doses
no4
Not Eligible for
Rescheduling of the Step into Prepared State
GEEServer Setting File: default.txt
GEEServer Host: 156.111.100.82
GEEServer Port: 8000
Patient ID: 1
Guideline ID: 106
GEEClient ID: 0
Primary GEEClient: Y
Log File: logfile
Thu Mar 07 11:29:44 EST 2002 GEEClient opened default GEEServer setting. GEEServer Host = 156.111.100.82. GEEServer Port = 8000. GEESe
Thu Mar 07 11:29:47 EST 2002 GEEClient connected to GEEServer. GEEClientID = 0
Thu Mar 07 11:29:53 EST 2002 GEEClient set patientID and guidelineID. PatientID = 1. GuidelineID = 106. PrimaryGEEClient = Y.
Thu Mar 07 11:29:54 EST 2002 GEEClient painted flowchart.

Fig. 16

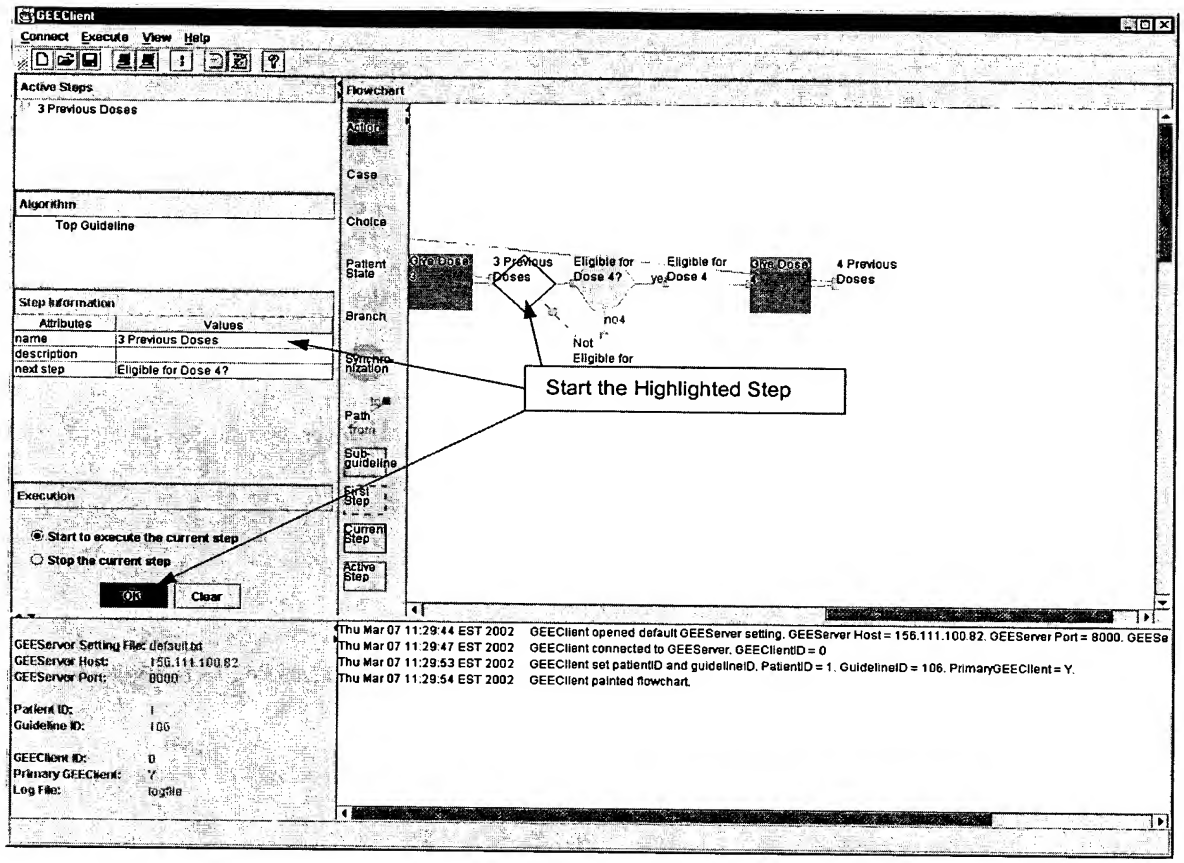
GEEClient
Connect Execute View Help
Active Steps
3 Previous Doses
Algorithm
Top Guideline
Step Information
Attributes
Values
name
3 Previous Doses
description
next step
Eligible for Dose 4?
Execution
Start to execute the current step
Stop the current step
OK
Clear
Flowchart
Action
Case
Choice
Patient State
Branch
Synchronization
Path
Sub-guideline
First Step
Current Step
Active Step
Give Dose
3 Previous Doses
Eligible for Dose 4?
Eligible for Dose 4
Give Dose
4 Previous Doses
no4
Not Eligible for
Start the Highlighted Step
GEEServer Setting File: default.txt
GEEServer Host: 156.111.100.82
GEEServer Port: 8000
Patient ID: 1
Guideline ID: 106
GEEClient ID: 0
Primary GEEClient: Y
Log File: logfile
Thu Mar 07 11:29:44 EST 2002 GEEClient opened default GEEServer setting. GEEServer Host = 156.111.100.82. GEEServer Port = 8000. GEESe
Thu Mar 07 11:29:47 EST 2002 GEEClient connected to GEEServer. GEEClientID = 0
Thu Mar 07 11:29:53 EST 2002 GEEClient set patientID and guidelineID. PatientID = 1. GuidelineID = 106. PrimaryGEEClient = Y.
Thu Mar 07 11:29:54 EST 2002 GEEClient painted flowchart.

Fig. 17

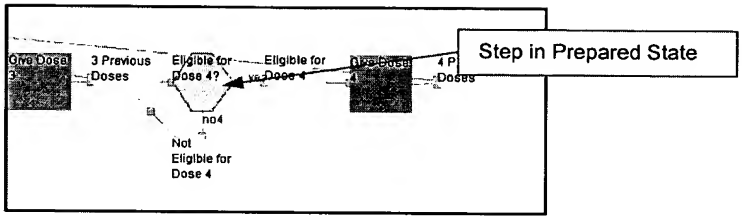

Fig. 18

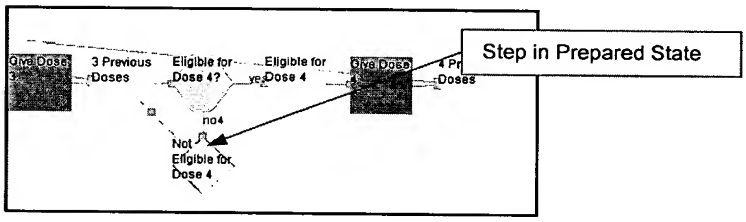

Fig. 19

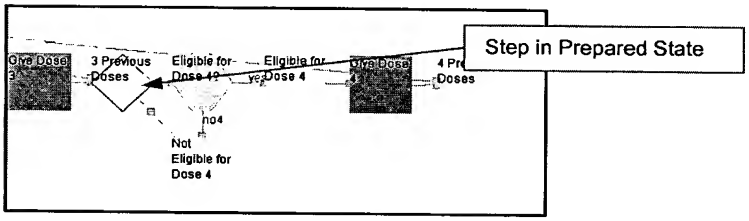

Fig. 20

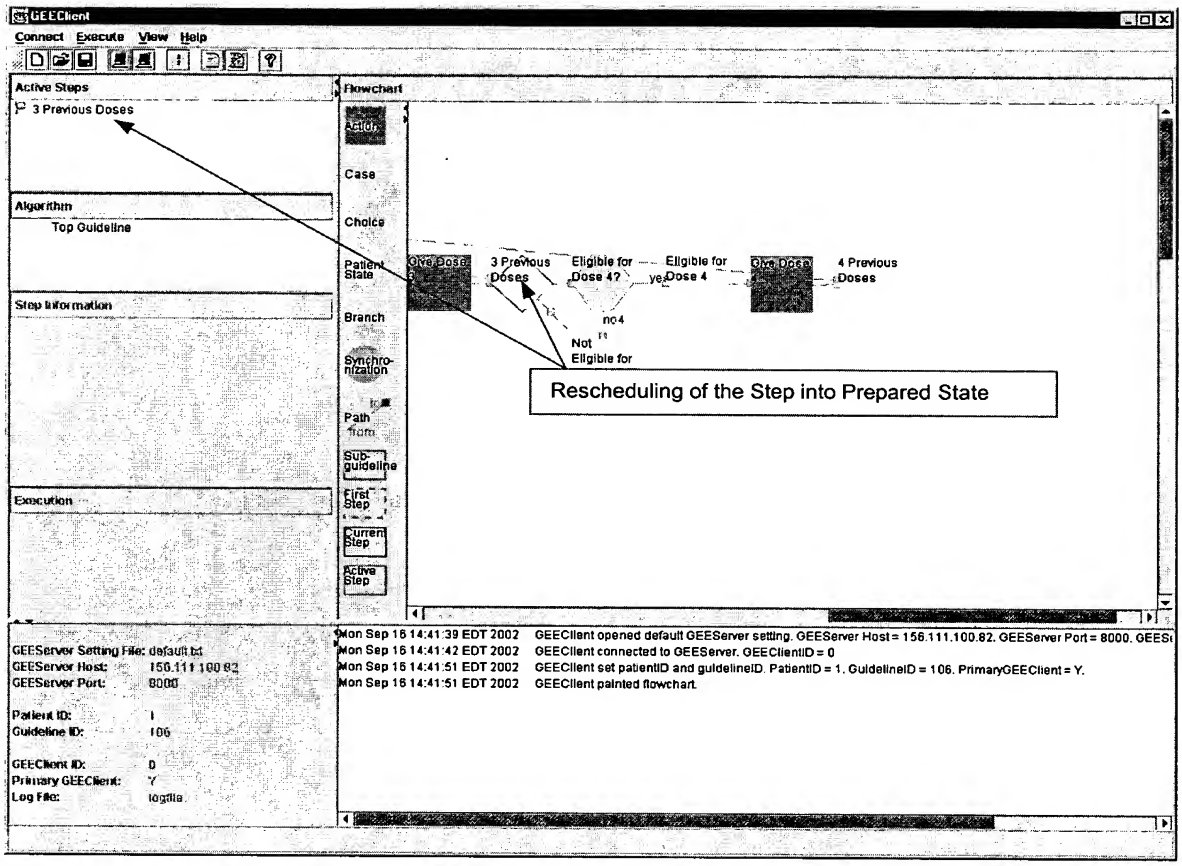
GEEClient
Connect Execute View Help
Active Steps
3 Previous Doses
Algorithm
Top Guideline
Step Information
Execution
Flowchart
Action
Case
Choice
Patient State
Branch
Synchro-nization
Path
Sub-guideline
First Step
Current Step
Active Step
Give Dose
3 Previous Doses
Eligible for Dose 4?
Eligible for Dose 4
Give Dose
4 Previous Doses
no4
Not Eligible for
Rescheduling of the Step into Prepared State
GEEServer Setting File: default.txt
GEEServer Host: 156.111.100.82
GEEServer Port: 8000
Patient ID: 1
Guideline ID: 106
GEEClient ID: 0
Primary GEEClient: Y
Log File: logfile
Mon Sep 16 14:41:39 EDT 2002 GEEClient opened default GEEServer setting. GEEServer Host = 156.111.100.82. GEEServer Port = 8000. GEESe
Mon Sep 16 14:41:42 EDT 2002 GEEClient connected to GEEServer. GEEClientID = 0
Mon Sep 16 14:41:51 EDT 2002 GEEClient set patientID and guidelineID. PatientID = 1. GuidelineID = 106. PrimaryGEEClient = Y.
Mon Sep 16 14:41:51 EDT 2002 GEEClient painted flowchart.

Fig. 21

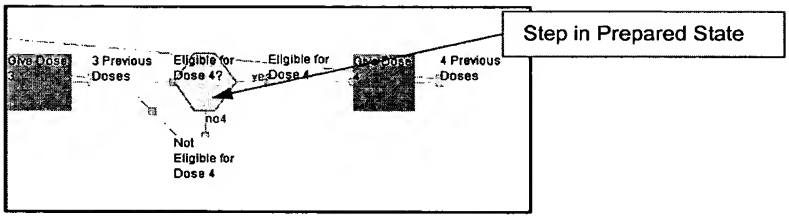
Step in Prepared State
Give Dose 3
3 Previous Doses
Eligible for Dose 4?
Eligible for Dose 4
Give Dose 4
4 Previous Doses
no4
Not Eligible for Dose 4

Fig. 22

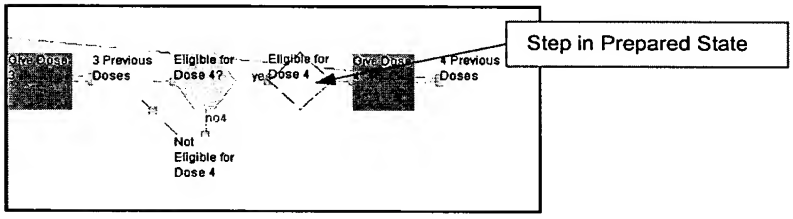
Step in Prepared State
Give Dose 3
3 Previous Doses
Eligible for Dose 4?
Eligible for Dose 4
Give Dose 4
4 Previous Doses
no4
Not Eligible for Dose 4

Fig. 23

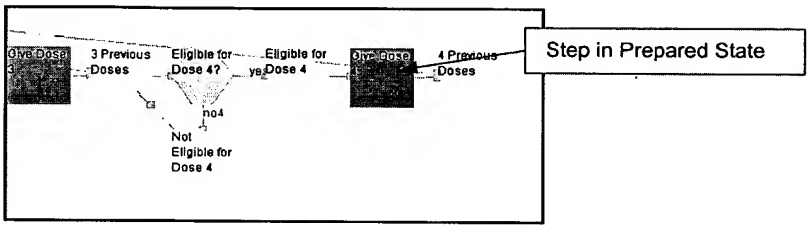
Give Dose
3 Previous Doses
Eligible for Dose 4?
Eligible for Dose 4
Give Dose
4 Previous Doses
Step in Prepared State
no4
Not Eligible for Dose 4

Fig. 24

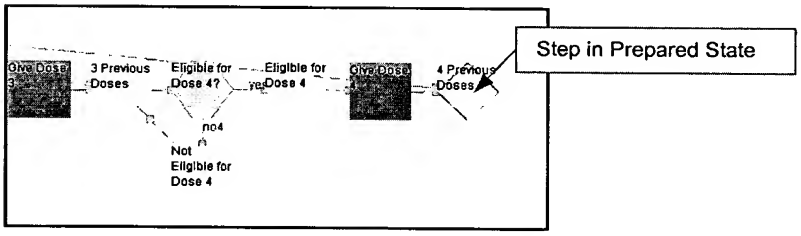
Give Dose
3 Previous Doses
Eligible for Dose 4?
Eligible for Dose 4
Give Dose
4 Previous Doses
Step in Prepared State
no4
Not Eligible for Dose 4

Fig. 25

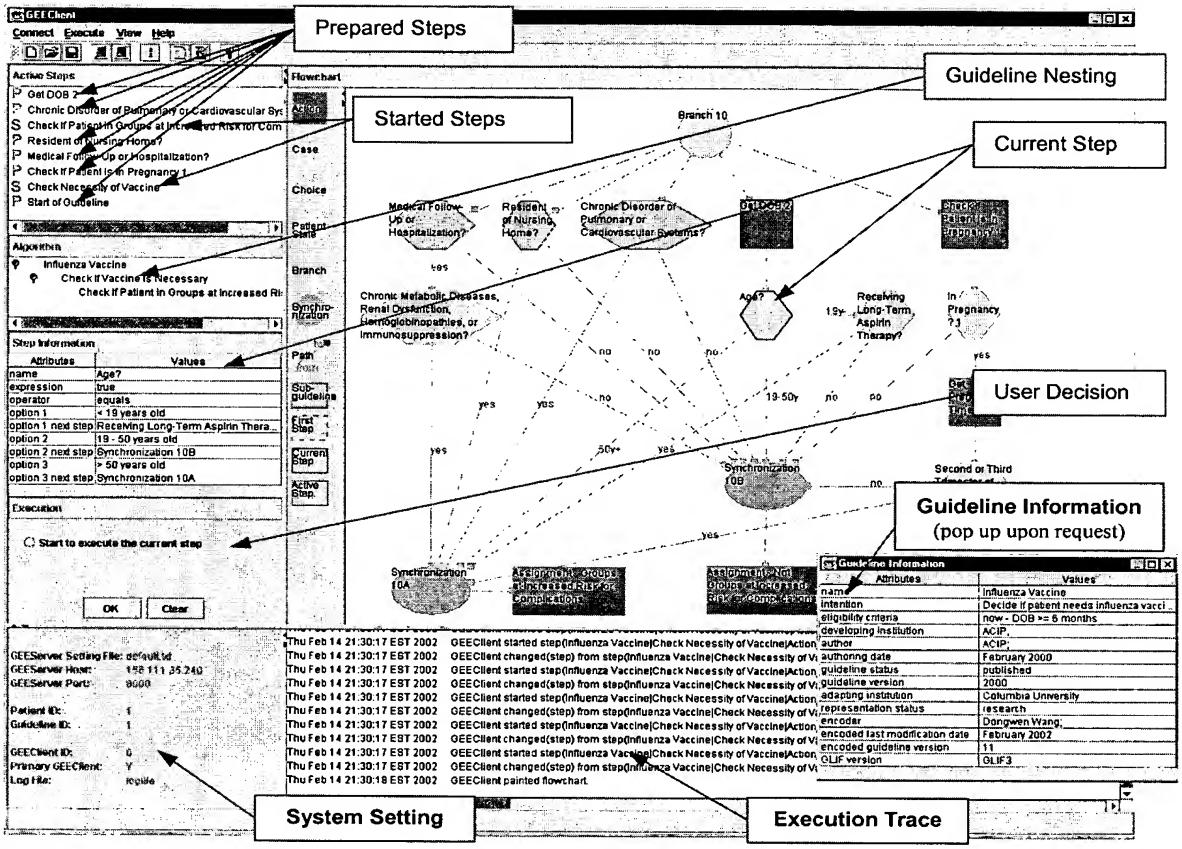
Prepared Steps
Guideline Nesting
Started Steps
Current Step
User Decision
Guideline Information
(pop up upon request)
System Setting
Execution Trace

Fig. 26

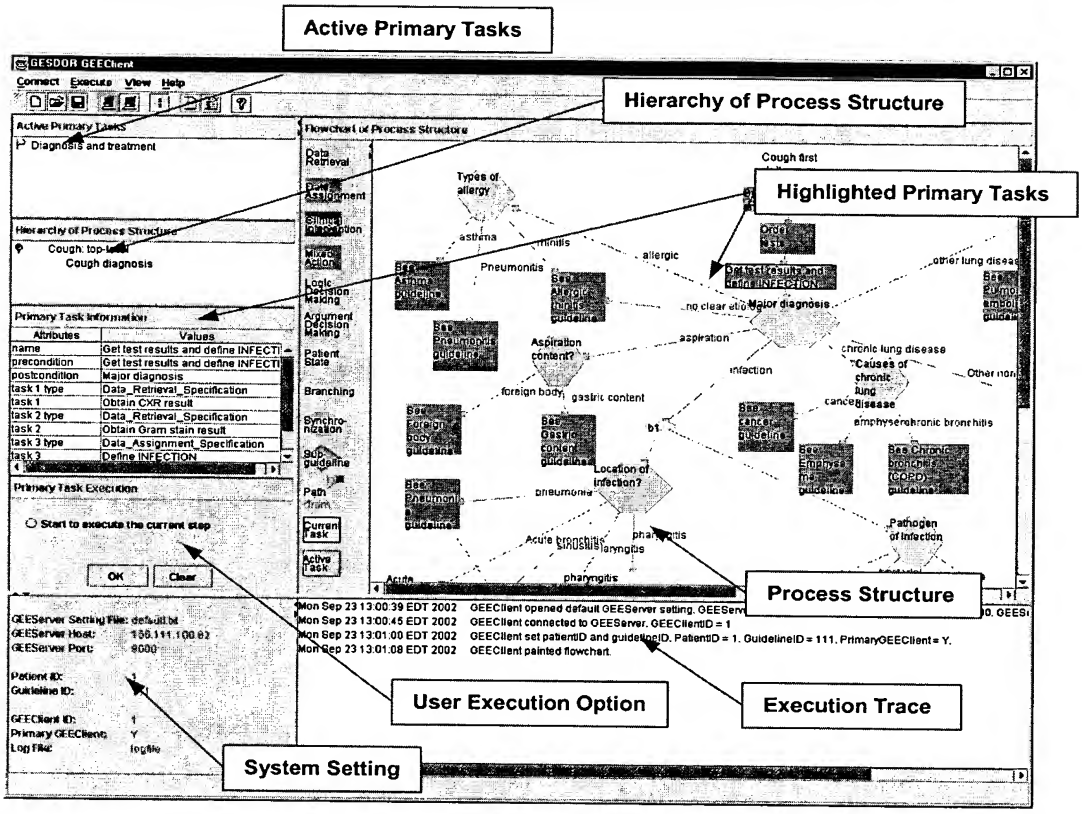
Active Primary Tasks
Hierarchy of Process Structure
Highlighted Primary Tasks
Process Structure
User Execution Option
Execution Trace
System Setting
GESDOR GEEClient
Connect Execute View Help
Active Primary Tasks
Diagnosis and treatment
Hierarchy of Process Structure
Cough: top-level
Cough diagnosis
Primary Task Information
Attributes
Values
name
Get test results and define INFECTI
precondition
Get test results and define INFECTI
postcondition
Major diagnosis
task 1 type
Data_Retrieval_Specification
task 1
Obtain CXR result
task 2 type
Data_Retrieval_Specification
task 2
Obtain Gram stain result
task 3 type
Data_Assignment_Specification
task 3
Define INFECTION
Primary Task Execution
Start to execute the current step
OK
Clear
Flowchart of Process Structure
Data Retrieval
Data Assignment
Situation Assessment
Action
Logic Decision Making
Argument Decision Making
Patient State
Branching
Synchronization
Sub-guideline
Path
Current Task
Active Task
Cough first
Types of allergy
asthma
rhinitis
allergic
Pneumonitis
Order CXR
Get test results and define INFECTION
Major diagnosis
no clear etiology
aspiration
Aspiration content?
infection
chronic lung disease
Causes of chronic lung disease
Other non-
foreign body
gastric content
cancer
emphysema
chronic bronchitis
bt
Location of infection?
pneumonia
Pathogen of Infection
Acute bronchitis
sinusitis
laryngitis
pharyngitis
Mon Sep 23 13:00:39 EDT 2002 GEEClient opened default GEEServer setting. GEEServ
Mon Sep 23 13:00:45 EDT 2002 GEEClient connected to GEEServer. GEEClientID = 1
Mon Sep 23 13:01:00 EDT 2002 GEEClient set patientID and guidelineID. PatientID = 1. GuidelineID = 111. PrimaryGEEClient = Y.
Mon Sep 23 13:01:08 EDT 2002 GEEClient painted flowchart.
GEEServer Setting File: default.txt
GEEServer Host: 136.111.100.82
GEEServer Port: 9000
Patient ID: 1
Guideline ID: 111
GEEClient ID: 1
Primary GEEClient: Y
Log File: logfile

Fig. 27

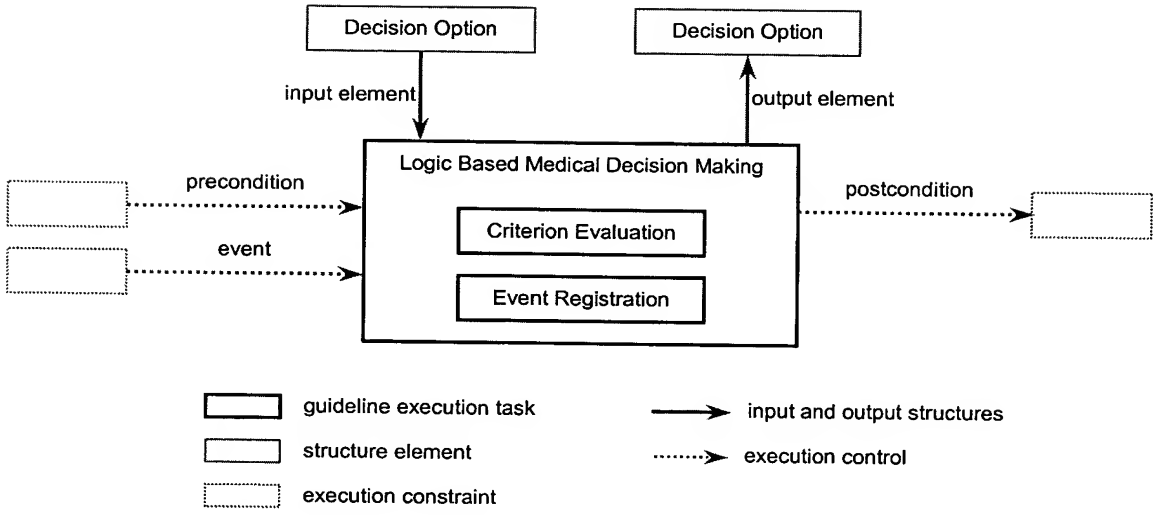
Decision Option
Decision Option
input element
output element
Logic Based Medical Decision Making
precondition
event
Criterion Evaluation
Event Registration
postcondition
guideline execution task
structure element
execution constraint
input and output structures
execution control

Fig. 28

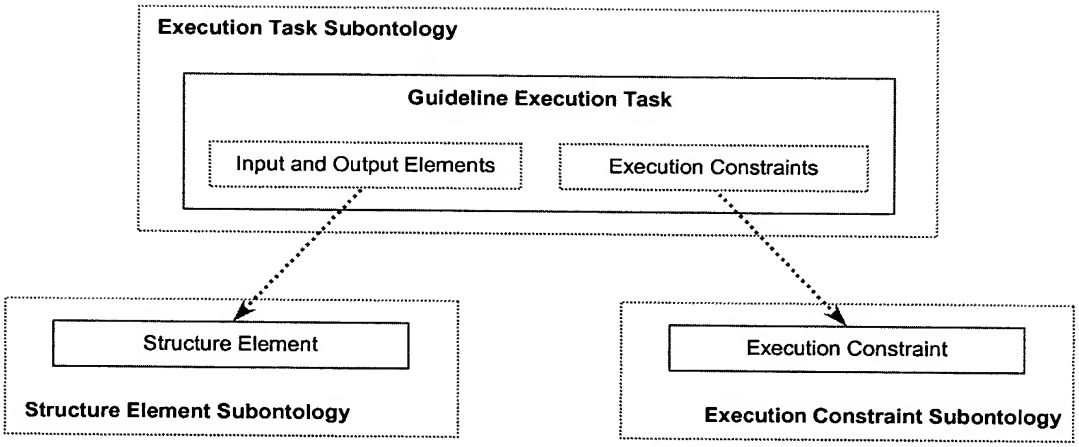
Execution Task Subontology
Guideline Execution Task
Input and Output Elements
Execution Constraints
Structure Element
Structure Element Subontology
Execution Constraint
Execution Constraint Subontology

Fig. 29

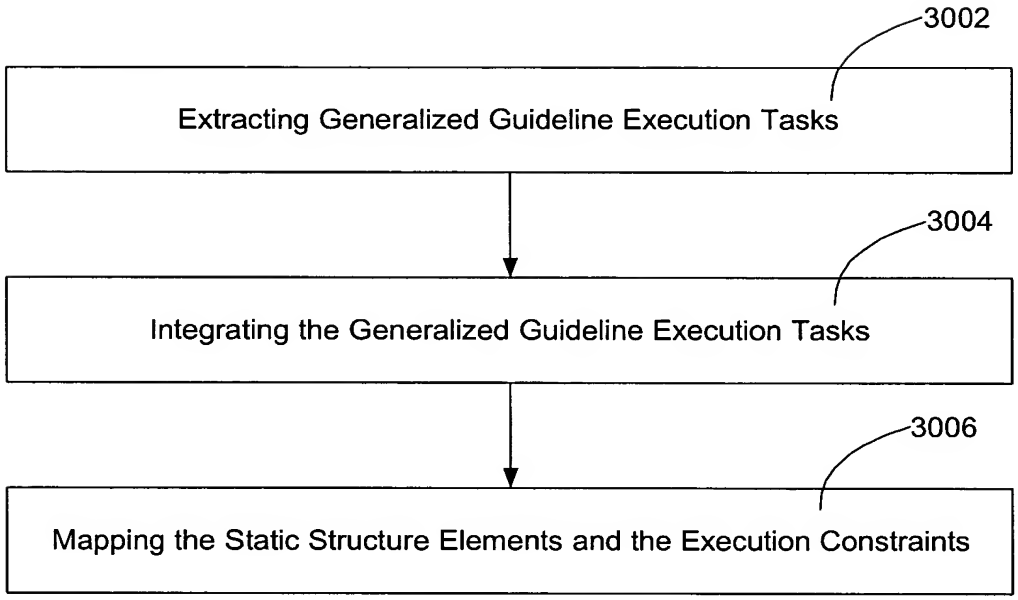
3002
Extracting Generalized Guideline Execution Tasks
3004
Integrating the Generalized Guideline Execution Tasks
3006
Mapping the Static Structure Elements and the Execution Constraints

Fig. 30

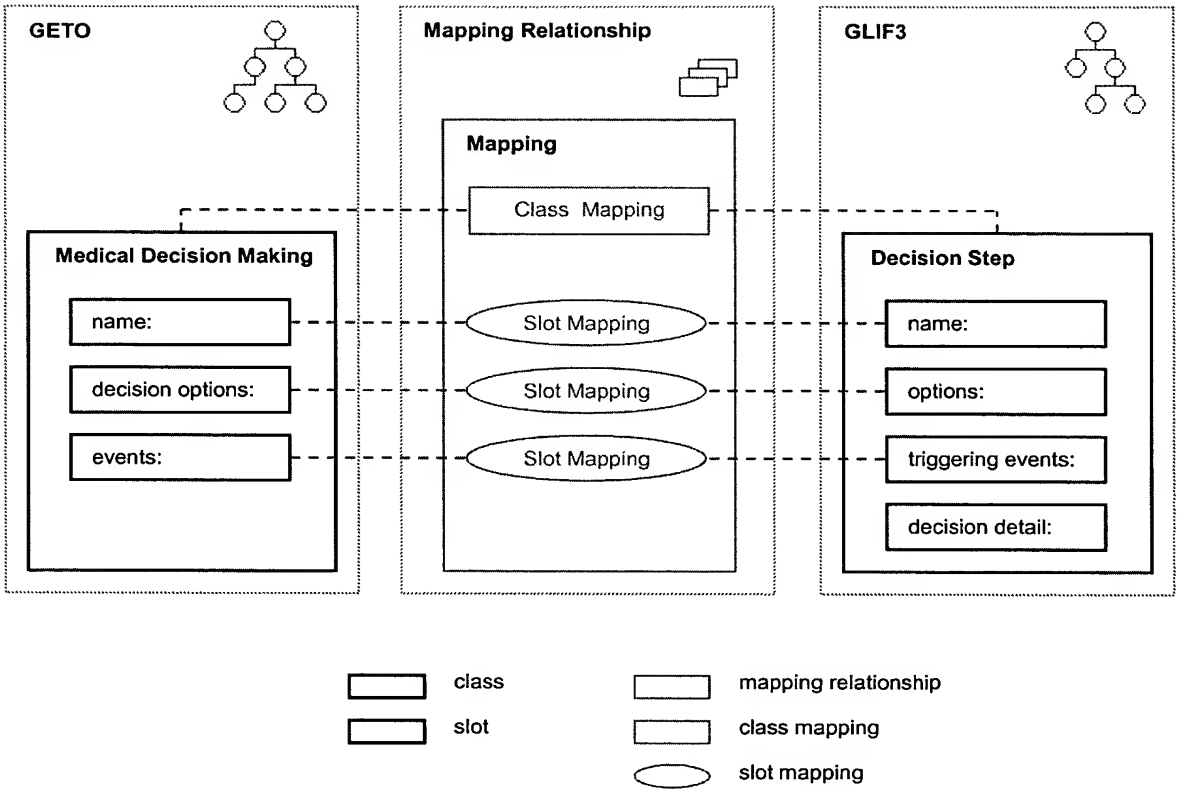
GETO
Mapping Relationship
GLIF3
Mapping
Class Mapping
Medical Decision Making
name:
decision options:
events:
Slot Mapping
Slot Mapping
Slot Mapping
Decision Step
name:
options:
triggering events:
decision detail:
class
slot
mapping relationship
class mapping
slot mapping

Fig. 31

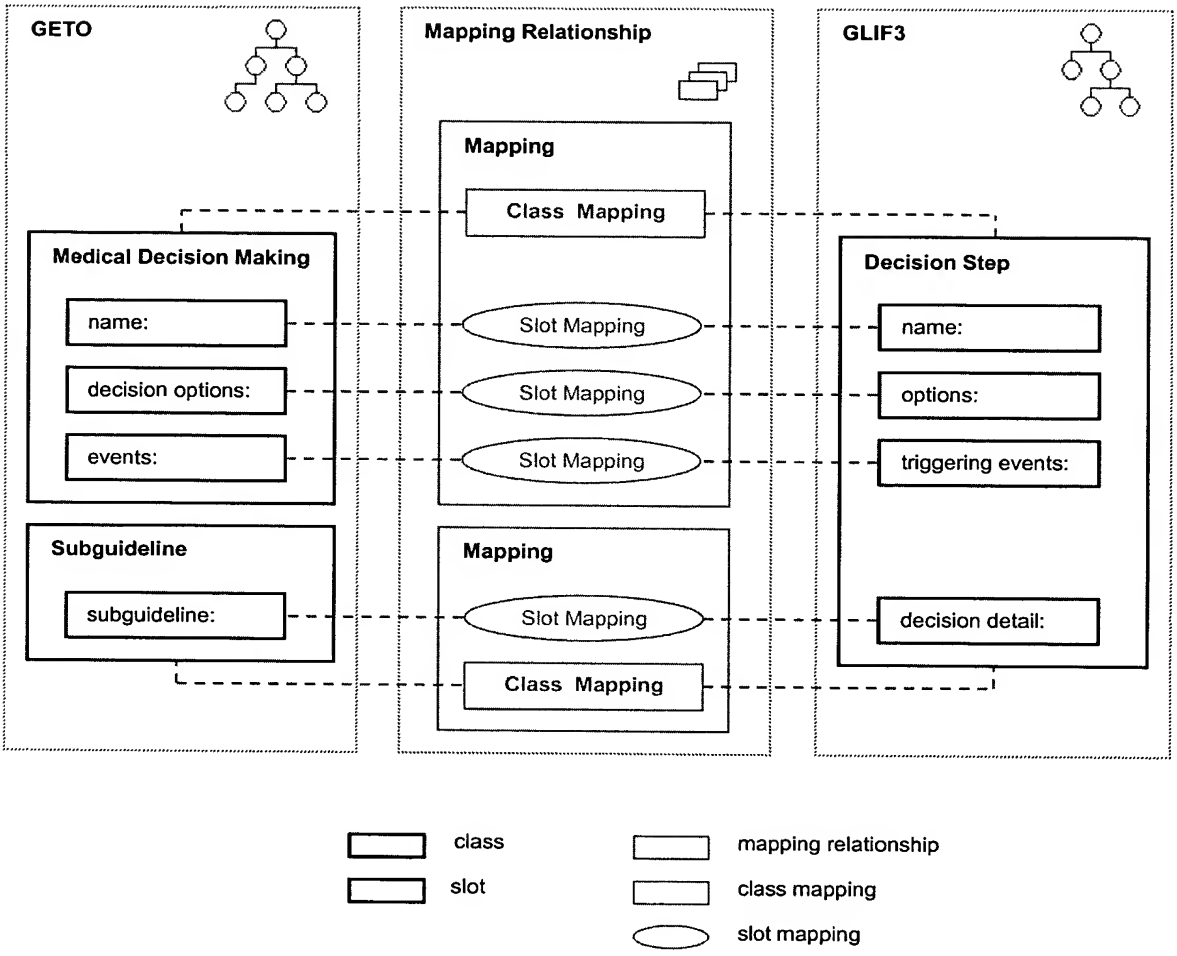
GETO
Mapping Relationship
GLIF3
Mapping
Class Mapping
Medical Decision Making
name:
decision options:
events:
Slot Mapping
Slot Mapping
Slot Mapping
Decision Step
name:
options:
triggering events:
Subguideline
subguideline:
Mapping
Slot Mapping
Class Mapping
decision detail:
class
slot
mapping relationship
class mapping
slot mapping

Fig. 32

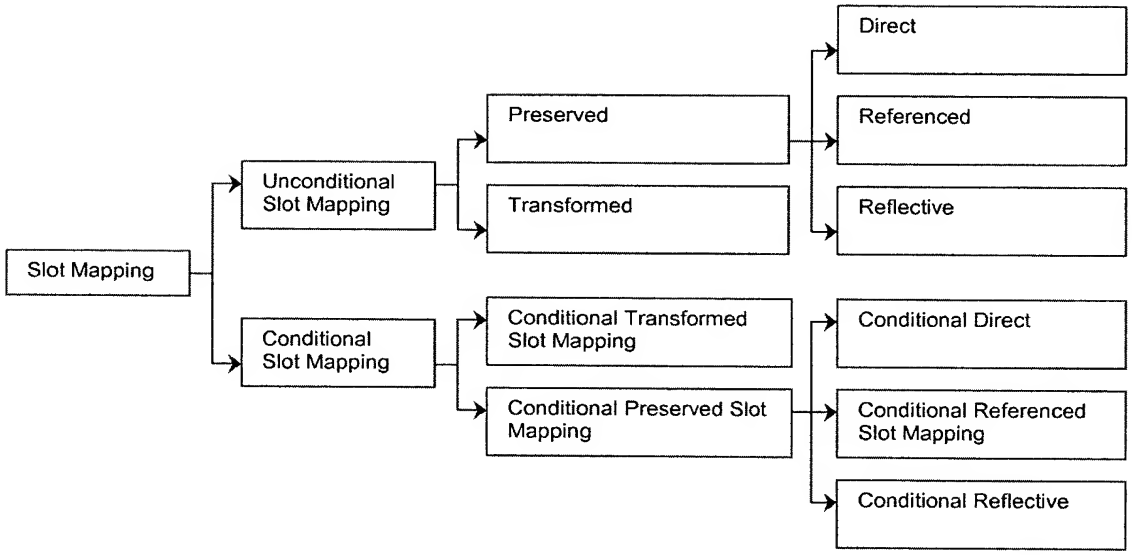
Slot Mapping
Unconditional Slot Mapping
Conditional Slot Mapping
Preserved
Transformed
Conditional Transformed Slot Mapping
Conditional Preserved Slot Mapping
Direct
Referenced
Reflective
Conditional Direct
Conditional Referenced Slot Mapping
Conditional Reflective

Fig. 33

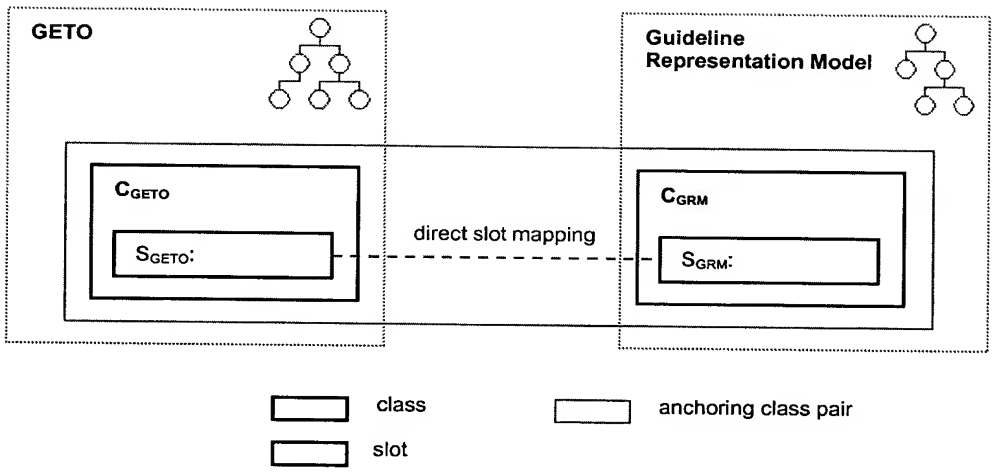
GETO
Guideline
Representation Model
CGETO
SGETO:
direct slot mapping
CGRM
SGRM:
class
slot
anchoring class pair

Fig. 34

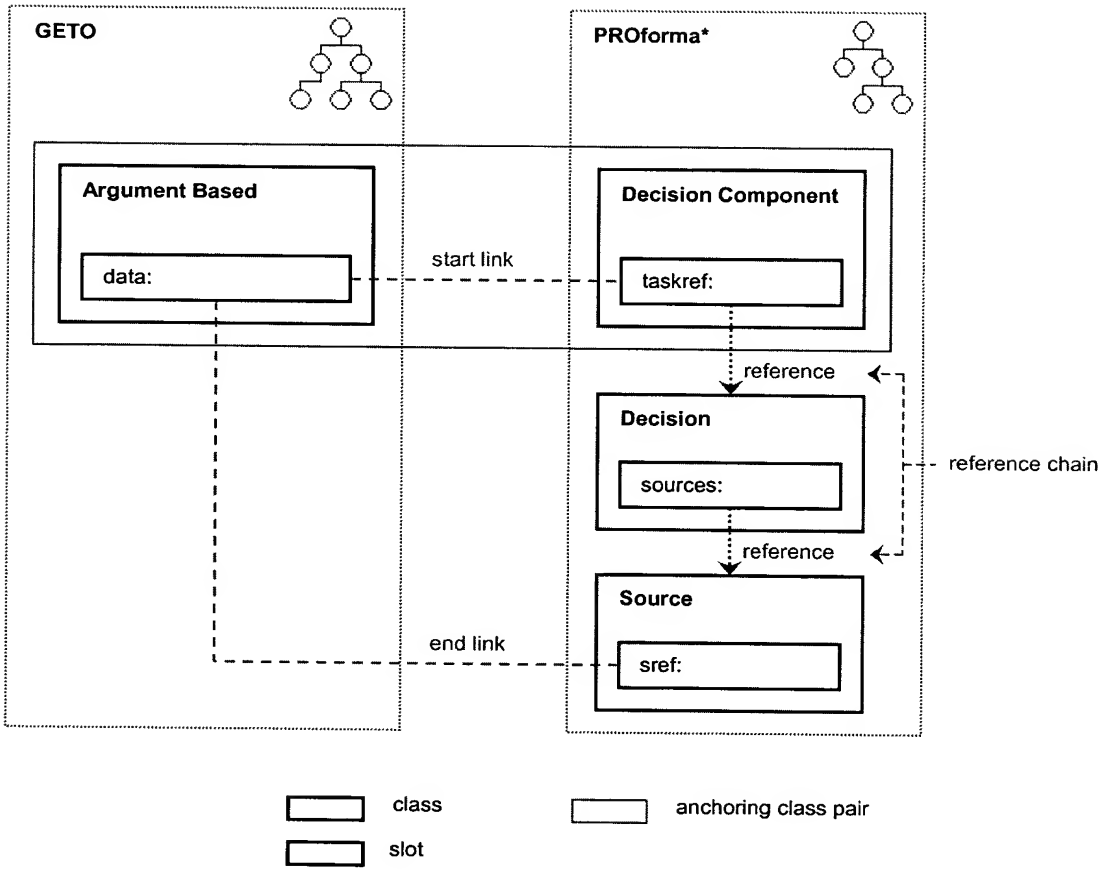
GETO
PROforma*
Argument Based
data:
start link
Decision Component
taskref:
reference
Decision
sources:
reference chain
reference
Source
sref:
end link
class
slot
anchoring class pair

Fig. 35

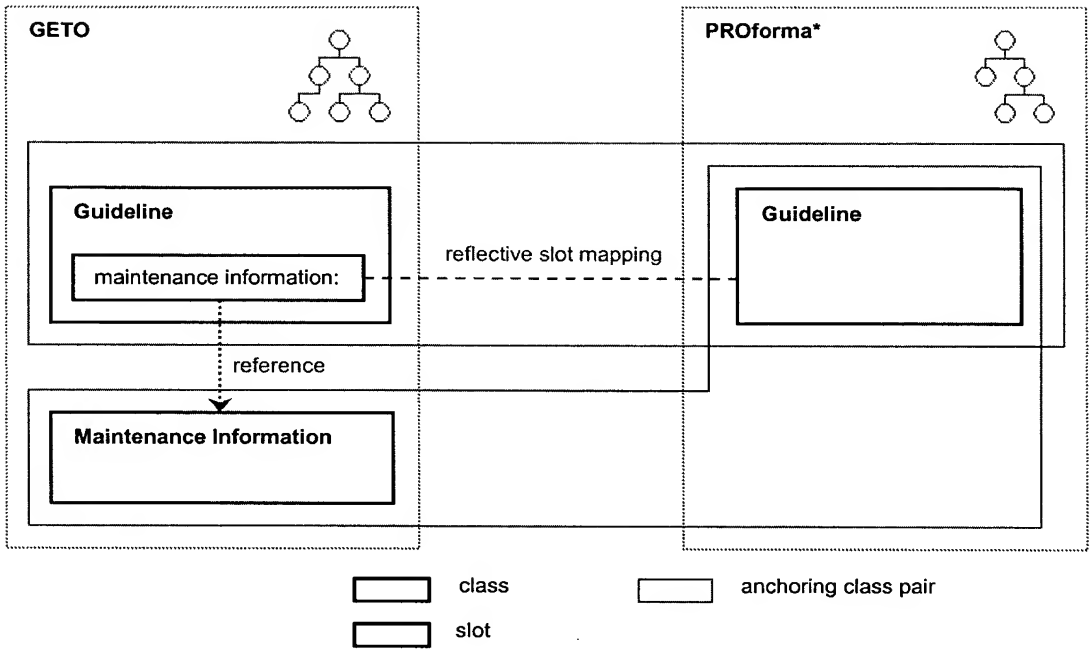
GETO
PROforma*
Guideline
maintenance information:
reflective slot mapping
Guideline
reference
Maintenance Information
class
anchoring class pair
slot

Fig. 36

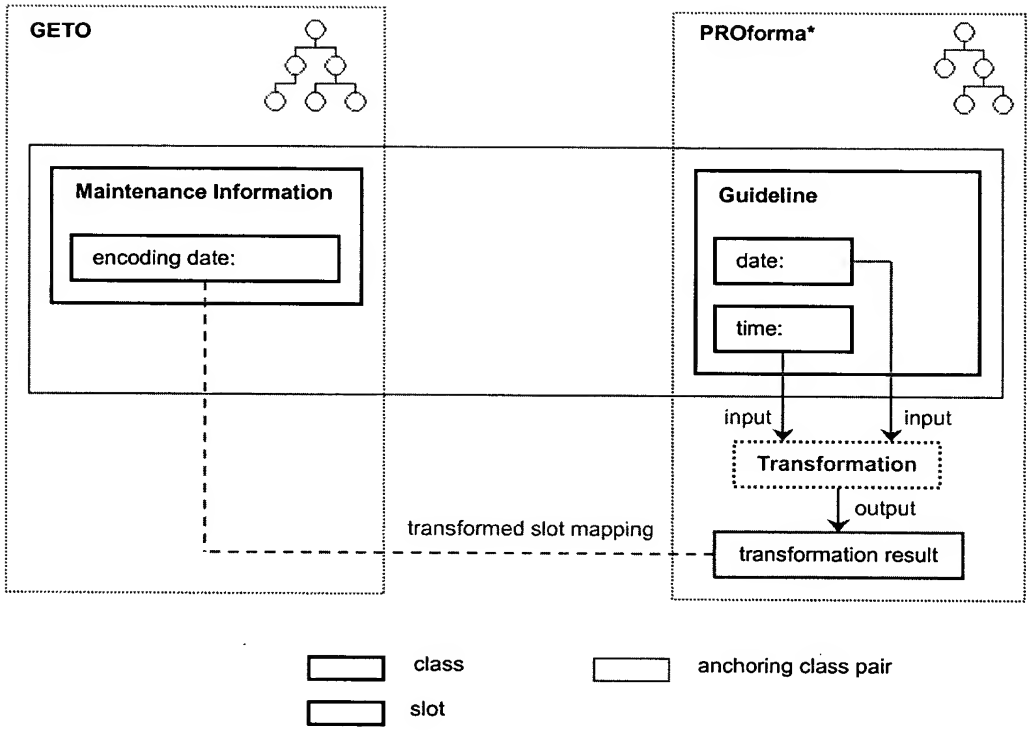
GETO
PROforma*
Maintenance Information
encoding date:
Guideline
date:
time:
input
input
Transformation
output
transformed slot mapping
transformation result
class
slot
anchoring class pair

Fig. 37

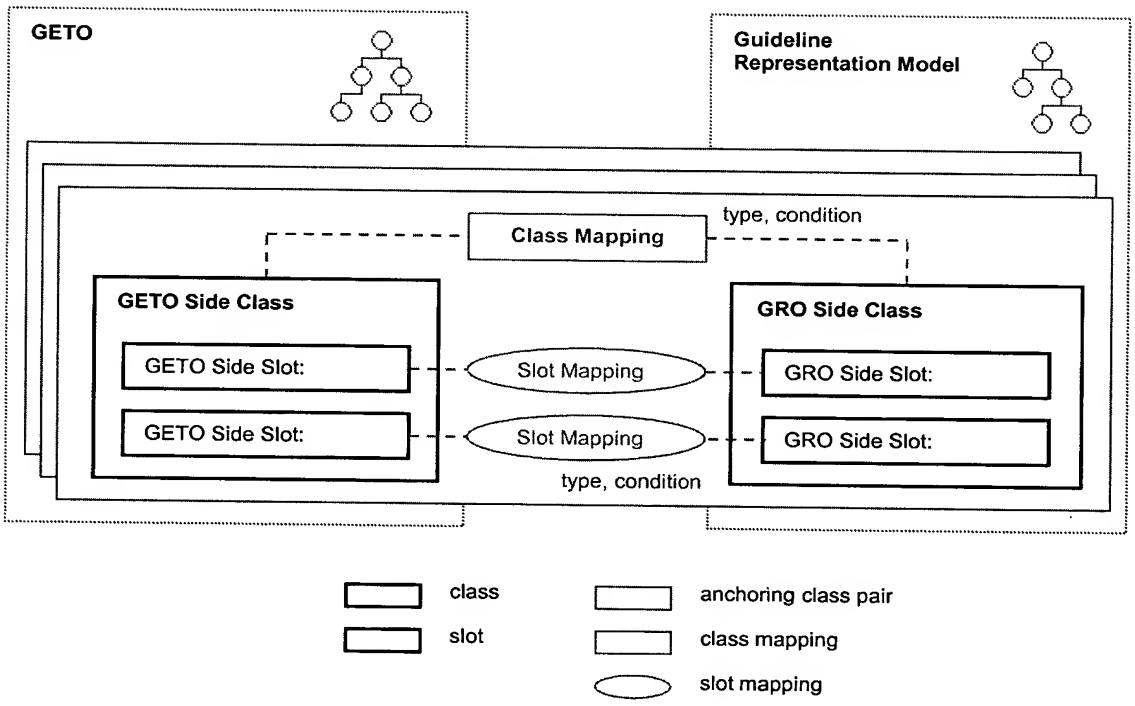
GETO
Guideline
Representation Model
Class Mapping
type, condition
GETO Side Class
GETO Side Slot:
GETO Side Slot:
Slot Mapping
Slot Mapping
type, condition
GRO Side Class
GRO Side Slot:
GRO Side Slot:
class
slot
anchoring class pair
class mapping
slot mapping

Fig. 38

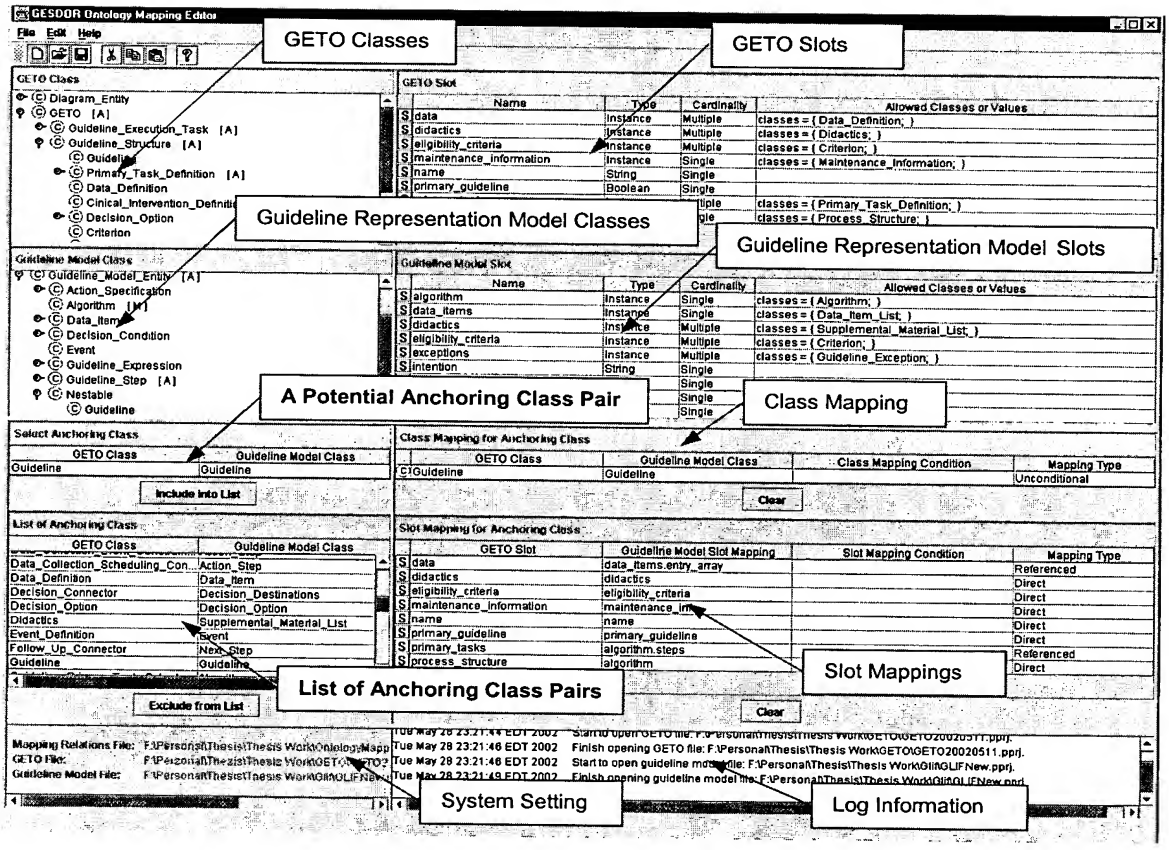
GESDOR Ontology Mapping Editor
File Edit Help
GETO Classes
GETO Slots
Guideline Representation Model Classes
Guideline Representation Model Slots
A Potential Anchoring Class Pair
Class Mapping
List of Anchoring Class Pairs
Slot Mappings
System Setting
Log Information
Include Into List
Exclude from List
Clear

Fig. 39

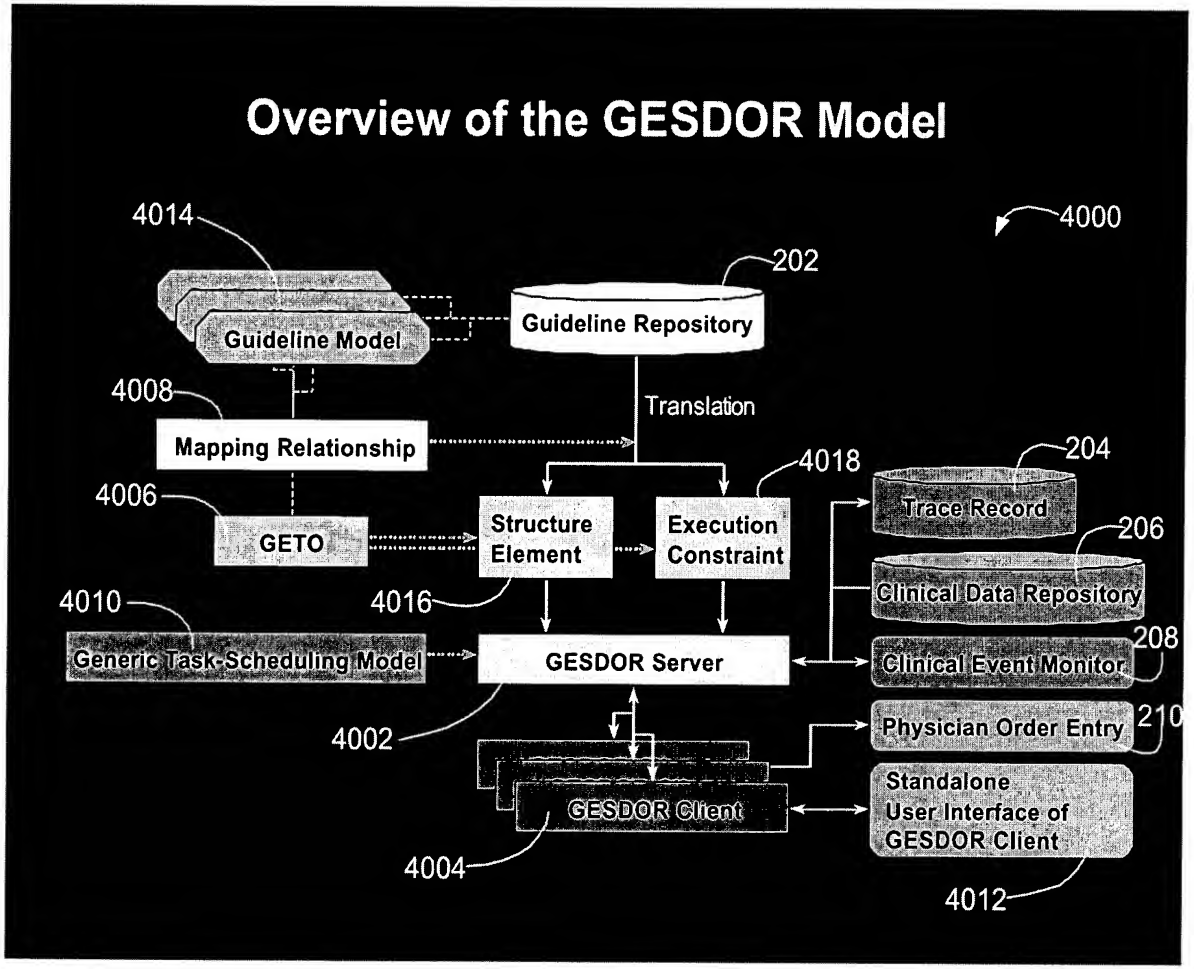
Overview of the GESDOR Model
4000
4014
Guideline Model
202
Guideline Repository
Translation
4008
Mapping Relationship
4018
204
Trace Record
4006
GETO
Structure Element
Execution Constraint
206
Clinical Data Repository
4010
4016
Generic Task-Scheduling Model
GESDOR Server
208
Clinical Event Monitor
210
Physician Order Entry
4002
GESDOR Client
Standalone User Interface of GESDOR Client
4004
4012

Fig. 40

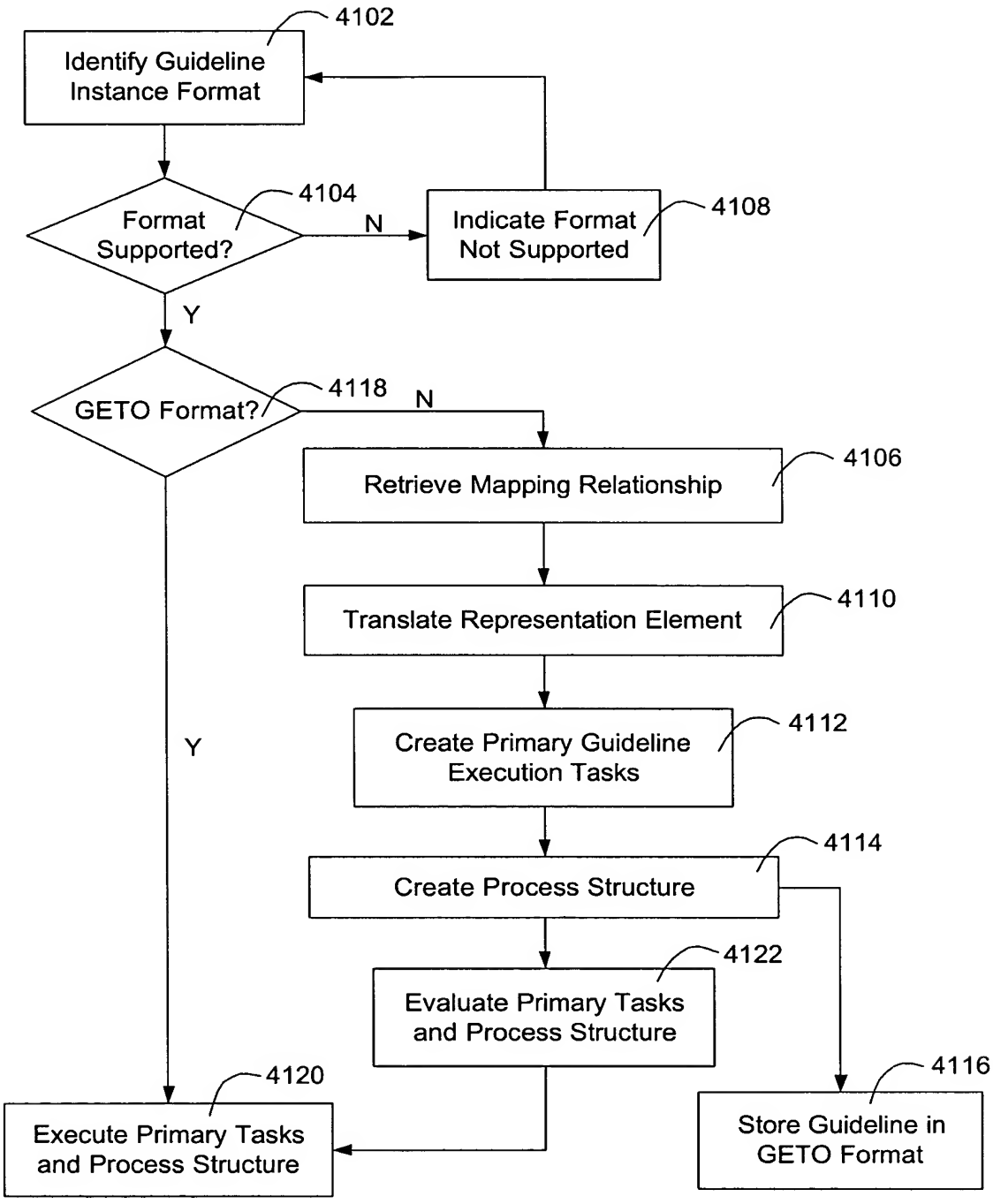
4102
Identify Guideline Instance Format
4104
Format Supported?
N
4108
Indicate Format Not Supported
Y
4118
GETO Format?
N
4106
Retrieve Mapping Relationship
4110
Translate Representation Element
4112
Create Primary Guideline Execution Tasks
Y
4114
Create Process Structure
4122
Evaluate Primary Tasks and Process Structure
4120
Execute Primary Tasks and Process Structure
4116
Store Guideline in GETO Format

Fig. 41

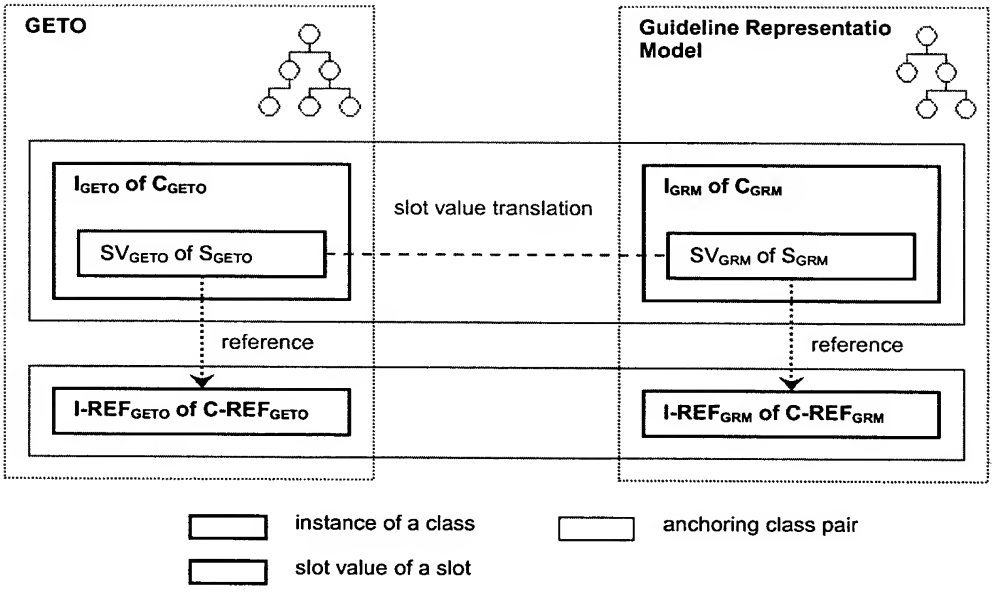
GETO
Guideline Representatio Model
I_{GETO} of C_{GETO}
SV_{GETO} of S_{GETO}
slot value translation
I_{GRM} of C_{GRM}
SV_{GRM} of S_{GRM}
reference
reference
I-REF_{GETO} of C-REF_{GETO}
I-REF_{GRM} of C-REF_{GRM}
instance of a class
slot value of a slot
anchoring class pair

Fig. 42

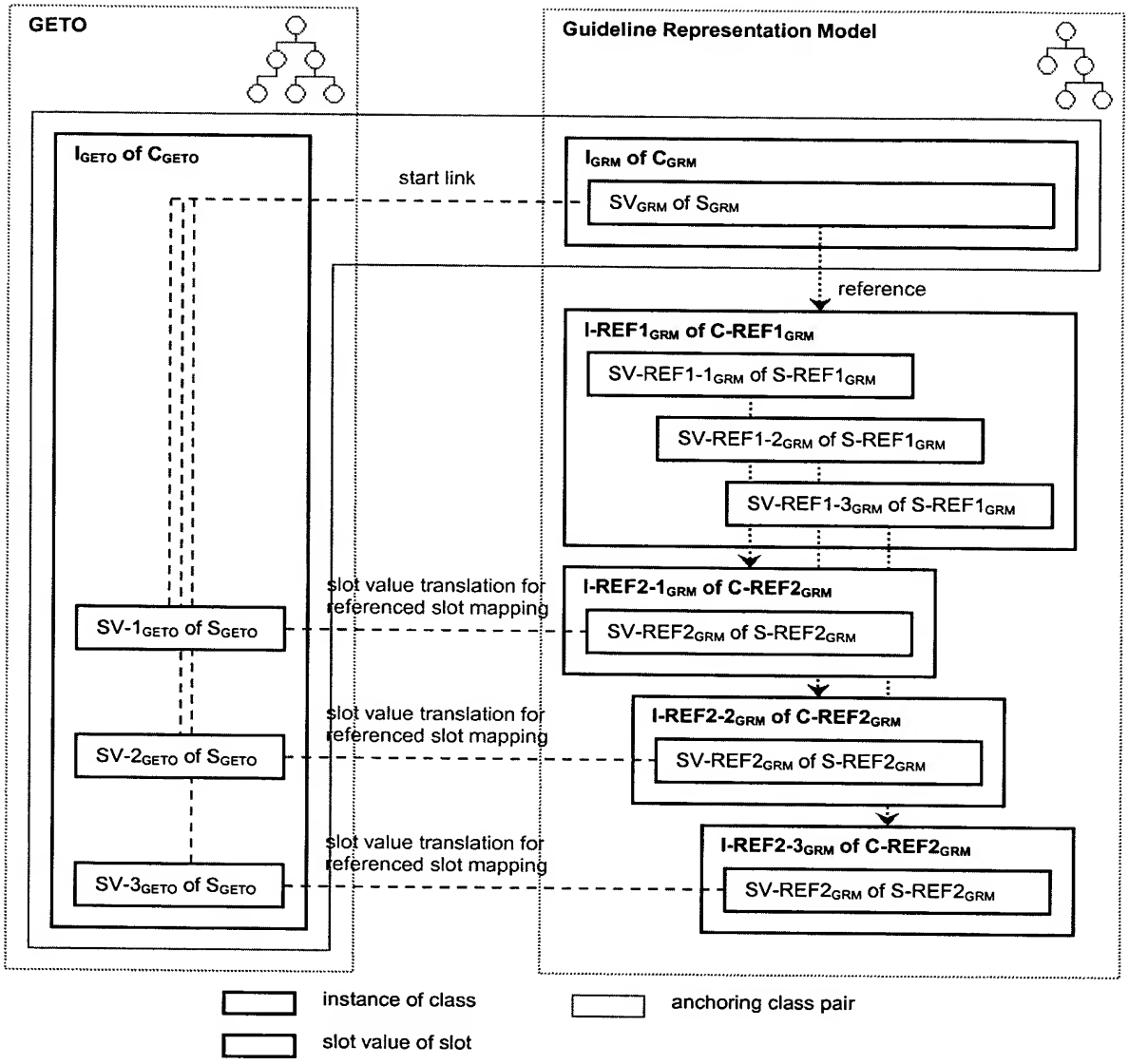
GETO
Guideline Representation Model
IGETO of CGETO
start link
IGRM of CGRM
SVGRM of SGRM
reference
I-REF1GRM of C-REF1GRM
SV-REF1-1GRM of S-REF1GRM
SV-REF1-2GRM of S-REF1GRM
SV-REF1-3GRM of S-REF1GRM
slot value translation for referenced slot mapping
I-REF2-1GRM of C-REF2GRM
SV-1GETO of SGETO
SV-REF2GRM of S-REF2GRM
slot value translation for referenced slot mapping
I-REF2-2GRM of C-REF2GRM
SV-2GETO of SGETO
SV-REF2GRM of S-REF2GRM
slot value translation for referenced slot mapping
I-REF2-3GRM of C-REF2GRM
SV-3GETO of SGETO
SV-REF2GRM of S-REF2GRM
instance of class
anchoring class pair
slot value of slot

Fig. 43

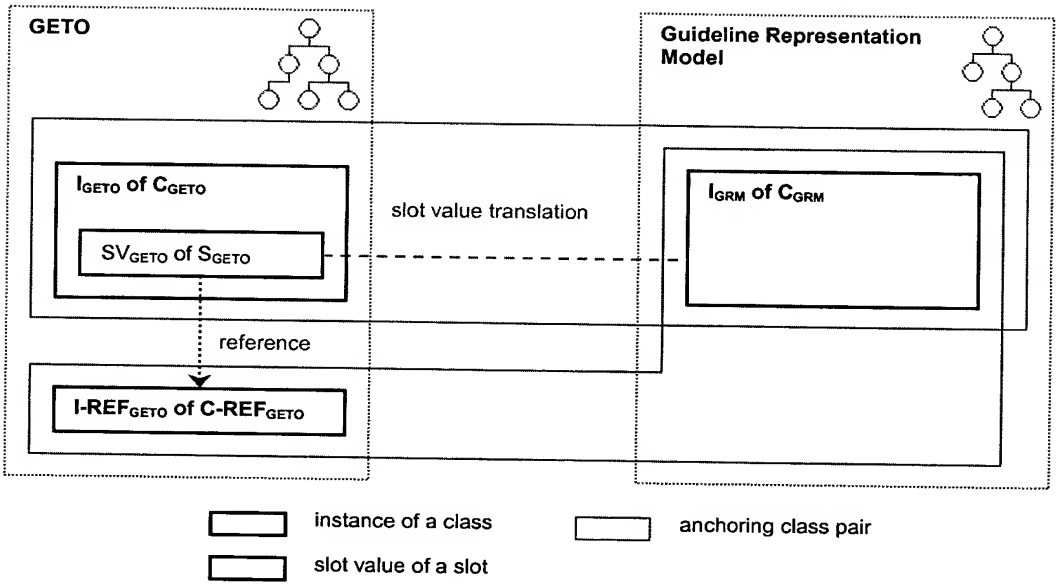
GETO
Guideline Representation Model
I_{GETO} of C_{GETO}
SV_{GETO} of S_{GETO}
slot value translation
I_{GRM} of C_{GRM}
reference
I-REF_{GETO} of C-REF_{GETO}
instance of a class
anchoring class pair
slot value of a slot

Fig. 44

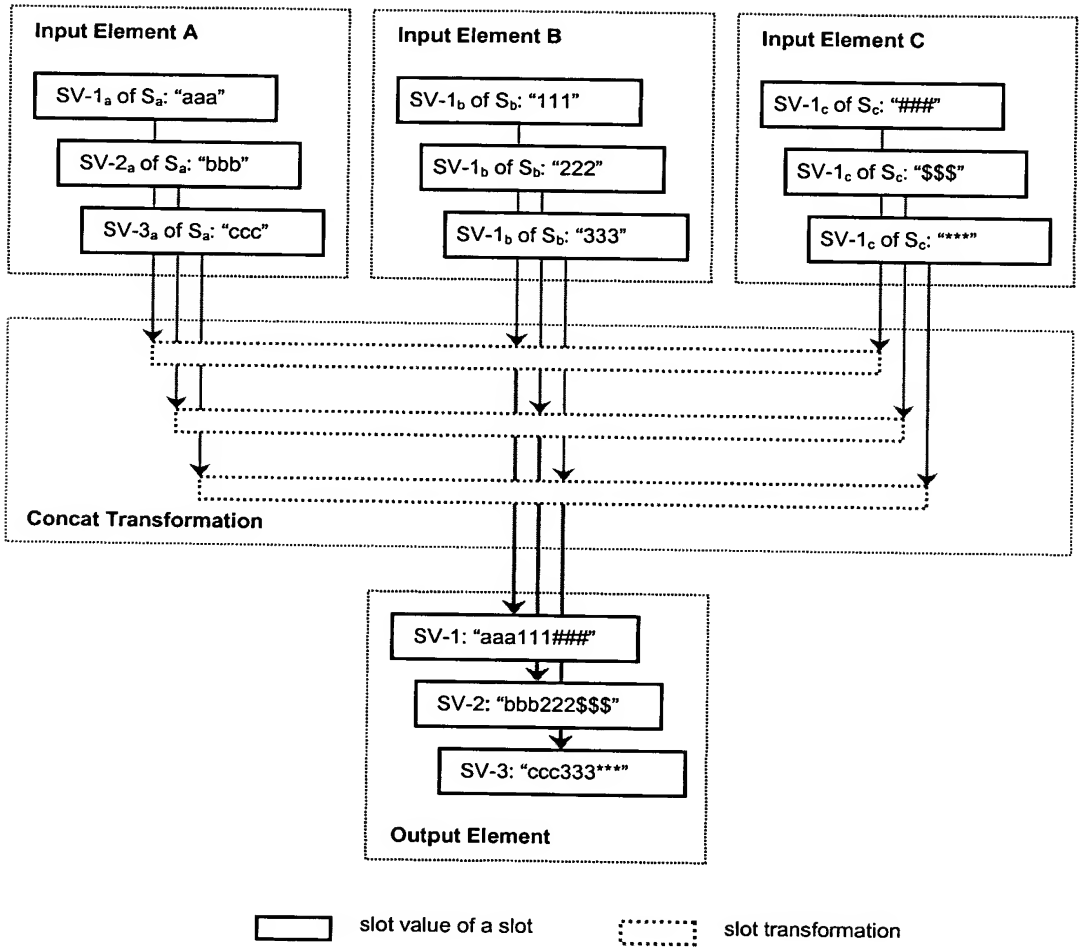
Input Element A
SV-1a of Sa: "aaa"
SV-2a of Sa: "bbb"
SV-3a of Sa: "ccc"
Input Element B
SV-1b of Sb: "111"
SV-1b of Sb: "222"
SV-1b of Sb: "333"
Input Element C
SV-1c of Sc: "###"
SV-1c of Sc: "$$$"
SV-1c of Sc: "***"
Concat Transformation
SV-1: "aaa111###"
SV-2: "bbb222$$$"
SV-3: "ccc333***"
Output Element
slot value of a slot
slot transformation

Fig. 45

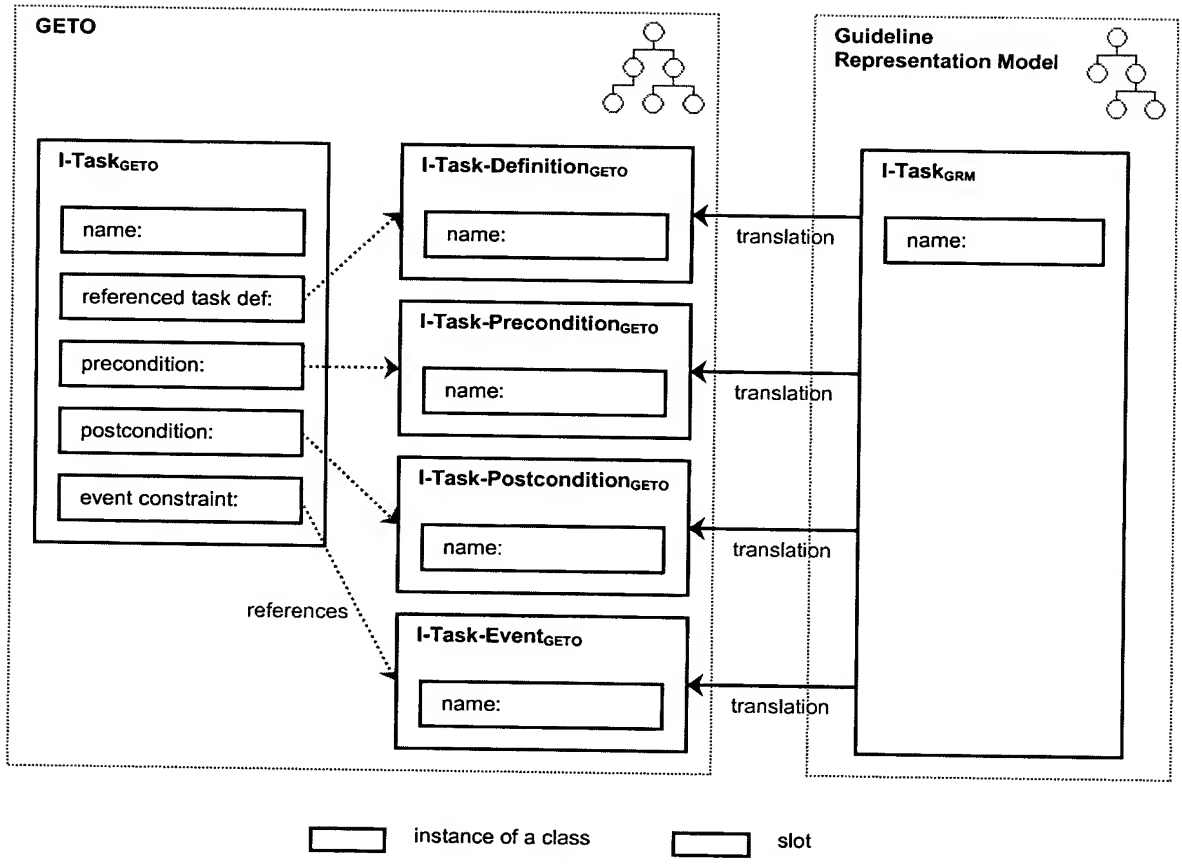
GETO
Guideline Representation Model
I-Task$_{GETO}$
name:
referenced task def:
precondition:
postcondition:
event constraint:
I-Task-Definition$_{GETO}$
name:
I-Task-Precondition$_{GETO}$
name:
I-Task-Postcondition$_{GETO}$
name:
I-Task-Event$_{GETO}$
name:
references
translation
translation
translation
translation
I-Task$_{GRM}$
name:
instance of a class
slot

Fig. 46

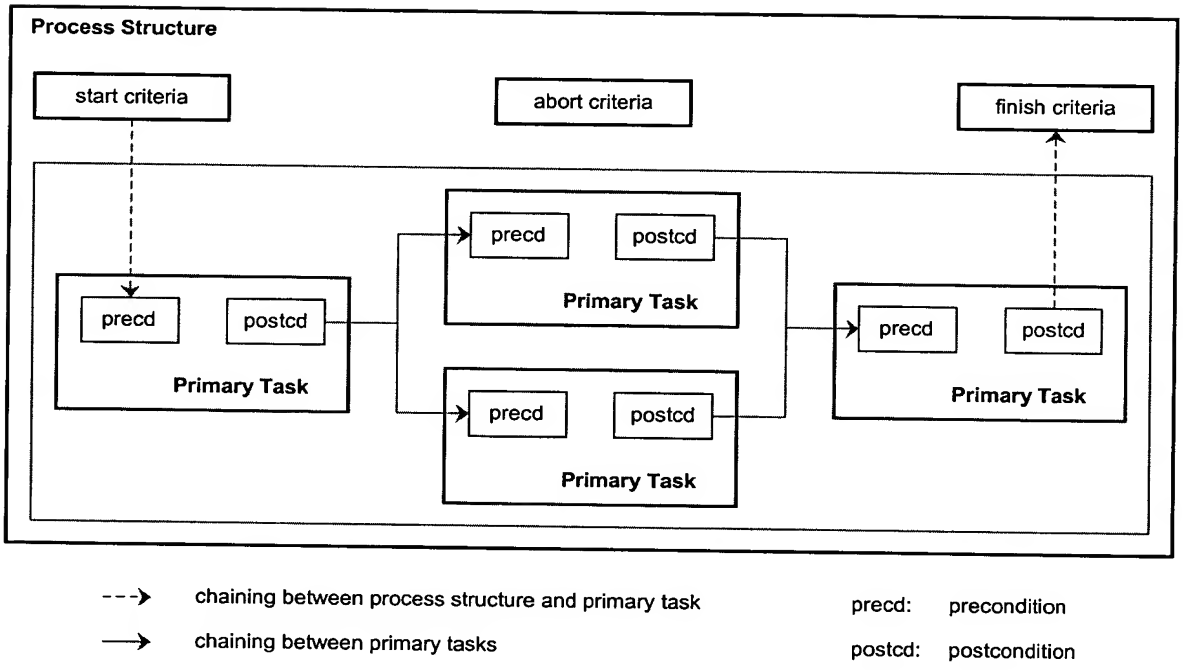
Process Structure
start criteria
abort criteria
finish criteria
precd
postcd
Primary Task
precd
postcd
Primary Task
precd
postcd
Primary Task
precd
postcd
Primary Task
chaining between process structure and primary task
chaining between primary tasks
precd: precondition
postcd: postcondition

Fig. 47

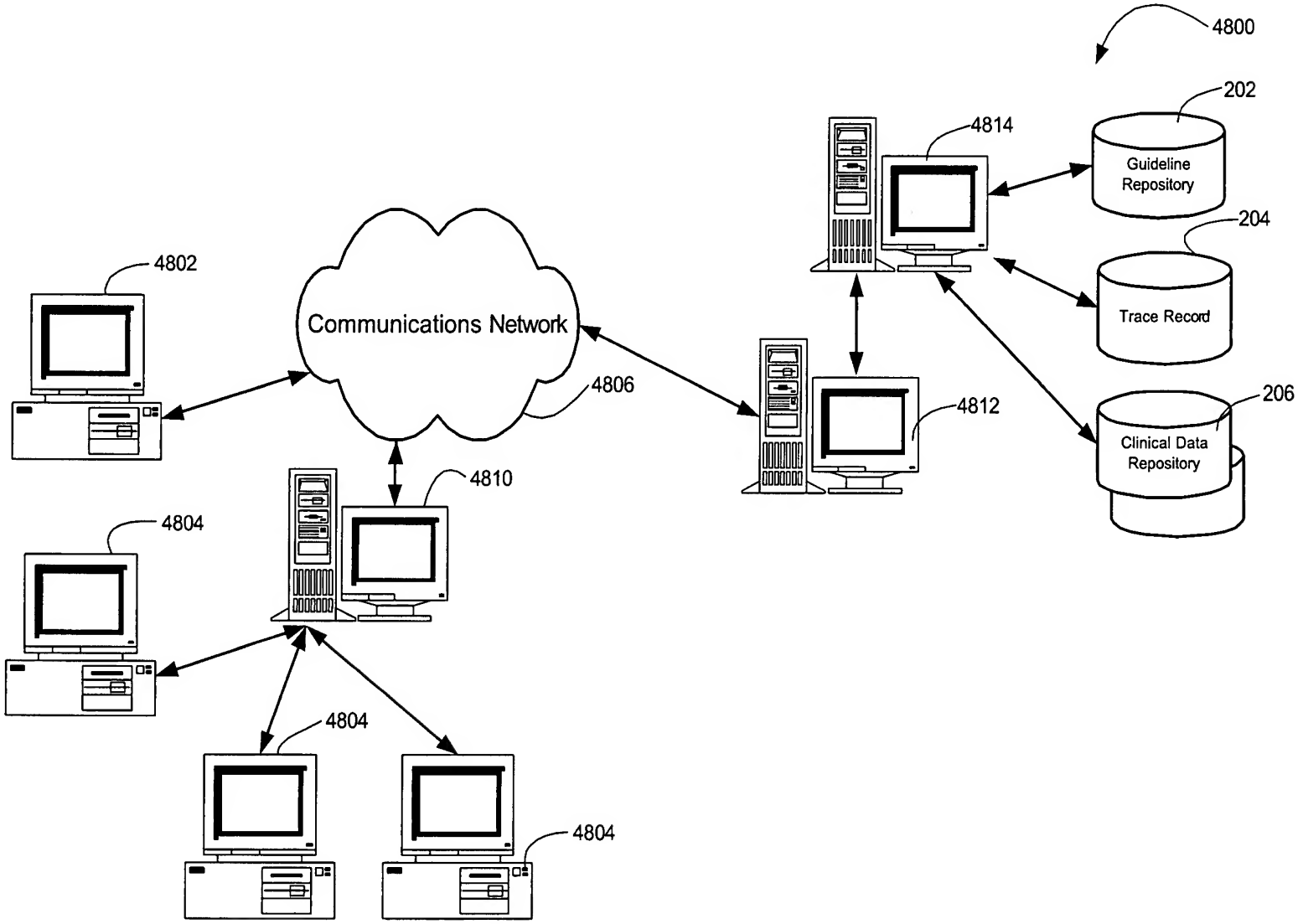
4800
202
4814
Guideline Repository
204
Trace Record
206
Clinical Data Repository
4802
Communications Network
4806
4812
4810
4804
4804
4804

Fig. 48